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REPORT

OF THE

MEDICAL SERVICES, MINISTRY OF HEALTH
SUDAN GOVERNMENT

FOR THE YEAR

1953/54





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CHAPTER I.

INTRODUCTION.

The cost of medical work further increased. This was in part due to expansion, but more largely to the raised cost of existing staff. The charge to the country for training medical students in the Kitchener School of Medicine is not shown in the budget of the ministry.

There was an improvement in the number of doctors engaged in general duties. The deficiencies in establishment were mainly made good by recruitment of expatriates, many of whom needed much acclimatization before they could satisfactorily fill the place of national practitioners.

The Sudan had its due share in medical advances, but, in so far as these tended towards an increasing trend to specialization they may not always produce the type of doctor which for long will be predominantly needed to fulfil the demands of medical work in the country.

The Minister of Health called a meeting of Province Medical Officers of Health and certain clinical specialists in March, 1954. Under the chairmanship of the Director the meeting studied a broad agenda covering many aspects of medical planning and organization. Agreed resolutions were submitted to the Minister for consideration in the formulation of policy. Stress was laid on the priority which should be given to rural medical services.

Although the lag was not overtaken there was some gathering of momentum in implementation of the proposals for expansion and improvement of health services. The Minister directed some modifications in the pattern of the development plan.

A grave epidemic of cerebrospinal meningitis attacked the Bahr El Ghazal for the second successive year. This Province was also visited by a severe outbreak of smallpox which had not been brought finally under control by the end of the year. Nor was control of smallpox in Darfur fully successful and the epidemic there continued, though at a lessened pitch.

A raised incidence of sporadic cases of enteric fever, and minor epidemics in Wadi Halfa, Dongola, Atbara, Abu Usher and Ed Dueim underlined the urgency of betterment of environmental sanitation throughout the country.

There was an ominous rise in incidence of sleeping sickness in Yambio and Yei districts.

The medical practitioner of relatively long experience must often have been impressed by the changed pattern of disease in many hospitals. The long rows of tropical ulcer have disappeared. Cases of degenerative ailments seemed considerably more frequent. Cardiovascular disease appeared a significant threat to the health of some sections of the population.

Extension of the railway from Sennar to Singa and Roseires may be followed by other developments which will mean a greater demand on medical services. The opening of the large Geneid Irrigation Scheme on the east bank of the Blue Nile

near Rufa'a will cause a marked increase of medical work. It was decided that medical administration of the Blue Nile Province is too great a task adequately to be carried by one man. An additional post of Province Medical Officer of Health was created with the duty of undertaking the medical administration of the Gezira Irrigated Area and future extensions thereto.

One Sudanese and one British member of the Service were appointed to Expert Panels of the World Health Organisation. An international team of W.H.O. began work on a B.C.G. immunization project. Members of the Eastern Mediterranean Region, W.H.O. and of the United Nations Childrens' Fund visited Khartoum and discussed future projects for co-operation between the Organisation and the Government.

The policy of sending Sudanese officials on study courses abroad was continued. One Sudanese doctor passed the examination for Membership of the Royal College of Physicians of Edinburgh and two gained a Diploma in Public Health (London).

CHAPTER II.

ADMINISTRATION.

(a) STAFF AND FUNCTIONS.

Table I shows the establishment of classified staff. Some categories of professional and technical staff were still under establishment. The table includes officials serving on secondment with local government authorities.

TABLE I.

SECTION	Establishment			
	British	Sudanese	Egyptian	Other
HEADQUARTERS.				
Director	1	—	—	—
Deputy Director	1	—	—	—
Asst. Director (Public Health)	—	1	—	—
Asst. Director (Hospitals)	—	1	—	—
Deputy A. Director (Public Health) ...	—	1	—	—
Deputy A. Director (Hospitals) ...	—	1	—	—
Inspector of Administration	—	1	—	—
Senior Establishment Officer	—	1	—	—
Establishment Officer	—	1	—	—
Asst. Establishment Officer	—	1	—	—
Principal Matron	1	—	—	—
Controller of Midwives	1	—	—	—
Chief Public Health Inspector	—	1	—	—
Principal School of Hygiene	—	1	—	—
Head Staff Clerk	—	1	—	—
Staff Clerk	—	4	—	—
Senior Clerk	—	9	—	—
Clerk	—	20	—	—
Junior Clerk	—	6	—	—
FINANCE BRANCH.				
Controller of Accounts	—	1	—	—
Inspector of Accounts	—	1	—	—
Head Accountant	—	1	—	1
Accountants	—	3	—	—
Senior Bookkeeper	—	4	—	—
Bookkeeper	—	21	—	—
Junior Bookkeeper	—	3	—	—
STORES SECTION.				
Controller Medical Stores	—	1	—	—
Asst. Controller Medical Stores ...	—	1	—	—
Supt. of Stores	—	1	—	—
Senior Storekeeper (including hors cadre post of Asst. Supt. Stores) ...	—	2	—	—
Storekeeper	—	18	—	—
Storekeeper under training	—	10	—	—
Junior Storekeeper	—	8	—	—
HOSPITALS AND DISPENSARIES.				
Senior Physician and Director, K.C.H. ...	—	1	—	—
Senior Surgeon	—	1	—	—
Senior Obstetrician and Gynaecologist ...	—	1	—	—
Senior Ophthalmologist	—	1	—	—
Physicians	4	7	—	—
Chest Physician	—	1	—	—
Psychiatrist	—	1	—	—

SECTION	Establishments			
	British	Sudanese	Egyptian	Other
Surgeon	6	3	—	—
Obstetrician and Gynaecologist	1	4	—	—
Ophthalmologist	—	4	—	—
Radiologist	—	1	—	—
Senior Medical Officer	—	12	—	—
Medical Inspector	1	16	—	—
Medical Officer	—	30	17	16
Medical Officer (hors cadre)	6	—	—	2
House Officers	—	18	—	—
Dental Surgeon	1	1	—	—
Dental Officer	—	—	1	—
Dental Mechanic	1	—	—	—
Dental Mechanic (Trainee)	—	2	—	—
Pharmacist	—	—	—	2
Lay Administrator (New K.C.H.)	1	1 (Trainee)	—	—
Senior Dispenser	—	20	—	—
Hospital Superintendent	—	3	—	—
Dispenser under Training	—	11	—	—
Controller Radiography	1	—	—	—
Radiographer	—	3	—	—
Assistant Radiographer	—	6	—	—
Asst. Radiographer under Training ...	—	11	—	—
Matron	4	—	—	—
Assistant Matron	11	—	—	—
Physiotherapist	4	—	—	—
Supt. Nursing Officer	5	1	—	—
Nursing Sister	31	—	—	—
Charge Nurse	—	5	—	—
Staff Nurse	—	22	—	—
Nursing Tutor (Male)	1	6	—	—
Nursing Tutor (Female)	—	15	—	—
Ophthalmic Assistant	—	2	—	—
Refractionist	—	2	—	—
Theatre Attendant	—	43	—	—
Bash Mumarid	—	41	—	—
Laboratory Technician	—	5	—	—
Senior Medical Assistant	—	15	—	—
Medical Assistant	—	413	—	—
Senior Clerk	—	6	—	—
Clerk	—	24	—	—
Junior Clerk	—	10	—	—
Senior Bookkeeper	—	13	—	—
Bookkeeper	—	17	—	—
Junior Bookkeeper	—	24	—	—
Senior Storekeeper	—	1	—	—
Storekeeper	—	14	—	—
Junior Storekeeper	—	5	—	—
Storekeeper U.T. (Southern Hospital) ...	—	10	—	—
Telephone Operator	—	6	—	—
Quarantine Overseer	—	2	—	—
Southern Trainees	—	10	—	—
Ration Clerk	—	28	—	—
Southern Bookkeeper (Class I)	—	1	—	—
	77	900	18	22

PUBLIC HEALTH.

Province Medical Officer of Health ...	1	9	—	—
Asst. Prov. Medical Officer of Health ...	—	7	—	—
Woman Doctor	5	—	—	2
Port Health Officer	1	—	—	—
Principal Midwives Training School ...	1	—	—	—
Asst. Principal Midwives Training School	—	1	—	—
Supt. Midwives Training	—	1	—	1

SECTION		Establishments			
		British	Sudanese	Egyptian	Other
Principal, H. Visitors T. School	...	1	—	—	—
Asst. Principal H. Visitors T. School	...	—	1	—	—
Staff Midwife	...	—	9	—	—
Staff Health Visitor	...	—	2	—	—
Senior Staff Midwife	...	—	2	—	—
Health Visitors	...	—	15	—	—
Senior Public Health Inspector	...	3	8	—	—
Public Health Inspector	...	—	11	—	—
Public Health Officer	...	—	37	—	—
Sanitary Overseer	...	—	145	—	—
Public Health Student Under Training		—	27	—	—
Senior Technical Clerk	...	—	1	—	—
Clerk	...	—	2	—	—
Junior Clerk	...	—	10	—	—
		12	288	—	2
RESEARCH AND LABORATORY SERVICES.					
(a) <i>Stack Medical Research.</i>					
Asst. Director (Research)	...	—	1	—	—
Bacteriologist	...	—	1	—	—
Pathologist	...	1	—	—	—
Registrar	...	—	1	—	—
Supt. of Laboratory	...	1	—	—	—
Laboratory Technician	...	3	3	—	—
Laboratory Assistant	...	—	62	—	—
Head Laboratory Attendant	...	—	2	—	—
Junior Technical Assistant	...	—	1	—	—
Senior Clerk	...	—	1	—	—
Clerk	...	—	1	—	—
Junior Clerk	...	—	1	—	—
(b) <i>Chemical Laboratories.</i>					
Government Analyst	...	1	—	—	—
Asst. Government Analyst	...	1	2	—	—
Asst. Scientific Officer U. Training	...	—	2	—	—
Senior Technical Assistant	...	—	2	—	—
Technical Assistant	...	—	5	—	—
Junior Technical Assistant	...	—	3	—	—
Clerk	...	—	1	—	—
(c) <i>Medical Entomology.</i>					
Medical Entomologist	...	1	—	—	—
Entomological Technician	...	—	1	—	—
Technical Assistant	...	—	1	—	—
Junior Technical Assistant	...	—	1	—	—
Junior Clerk	...	—	1	—	—
(d) <i>Schistosomiasis Research.</i>					
Biologist	...	—	—	—	1
Senior Technical Assistant	...	—	1	—	—
Technical Assistant	...	—	1	—	—
Clerk	...	—	1	—	—
Storekeeper	...	—	1	—	—
(e) <i>Graphic Museum.</i>					
Assistant Curator	...	—	1	—	—
Museum Attendant	...	—	1	—	—
TOTAL	...	8	99	—	1
GRAND TOTAL	...	101	1412	18	25

Employees not on establishment numbered 6480 approximately.

(b) LEGISLATION.

The following legislation effecting public health was enacted during the year :—

Ordinances.

N I L

Rules and Orders.

Date	Short Title	Provision
31.12.53	The Poisons Order Amendment No. 1 Order.	Addition of N-allylnormorphine to Part 1 of Poisons List.

(c) FINANCE.

TABLE II (A).

Income and Expenditure of Ministry of Health over the

Last 4 years.

ITEM	1950/51	1951/52	1952/53	1953/54
	£E.	£E.	£E.	£E.
Revenue	61,845	46,779	49,917	48,397
<i>Expenditure :—</i>				
Personnel and Personal Allowances ...	1,208,239	1,222,093	1,308,294	1,363,593
Services	926,374	777,647	969,907	1,184,092
Extraordinary	35,434	32,489	24,944	34,188
	2,170,047	2,032,229	2,303,145	2,581,873

TABLE II (B).

Analysis of the Expenditure 1953/54.

SECTION	Personal	Services	Extra- ordi-nary	Total
	£E.	£E.	£E.	£E.
(a) Headquarters	96,720	327,983	—	424,703
(b) Hospitals and Dispensaries	1,032,914	752,913	34,188	1,820,015
(c) Hygiene and Public Health	178,768	97,052	—	275,820
(d) Research	53,821	6,144	—	59,965
(e) Graphic Museum	1,370	—	—	1,370
TOTAL	1,363,593	1,184,092	34,188	2,581,873

CHAPTER III.

PUBLIC HEALTH.

(a) HEALTH OF OFFICIALS.

TABLE III.

NATIONALITY	Number of officials employed	Number placed on sick list	No. of days sick	Average days sickness		Died	Invalided	
				For all officials	For those reported sick			
British	1952/53	1,174	142	944	0.80	6.65	1	2
	1953/54	1,111	185	1,101	0.99	5.95	1	3
Sudanese	1952/53	7,871	2,703	20,350	2.58	7.53	8	6
	1953/54	8,774	2,219	20,347	2.32	9.17	5	8
Others	1952/53	196	27	228	1.16	8.44	0	0
	1953/54	164	47	393	2.39	8.36	0	3

(b) GENERAL HEALTH.

Gradual expansion of facilities, advances in medical treatment which made possible a shorter average "patient-stay" in hospital and, above all, an ever-growing public desire for orthodox medical care are mirrored in the general upward trend of work done in hospitals and dispensaries. Until curative and public health services are stabilized at the attainable optimum the state of the public health is probably not measurable by returns from medical units. Table IV illustrates the generally rising trend of work done in hospitals and dispensaries over ten years.

TABLE IV.

Work done in hospitals and dispensaries.

YEAR							Admissions	Attendances	Operations
1944	...	...	...	...	...	...	131,077	7,077,919	13,796
1945	...	...	...	...	...	...	131,571	7,897,148	15,455
1946	...	...	...	...	...	...	126,586	8,474,874	15,509
1947	...	...	...	...	...	...	142,294	9,253,251	16,785
1948	...	...	...	...	...	...	140,511	9,820,304	17,573
1949	...	...	...	...	...	...	151,011	10,186,668	21,327
1950/51 (18 months)	...	...	...	...	...	...	302,526	16,503,371	31,459
1951/52	...	...	...	...	...	...	168,251	12,181,931	26,021
1952/53	...	...	...	...	...	...	164,331	13,966,390	26,114
1953/54	...	...	...	...	...	...	172,675	14,483,366	34,432

There were 74 licensed private practitioners in June, 1954. The work done by them must have added appreciably to the sum of medical work.

(c) VITAL STATISTICS.

No accurate census of the population of the whole country has been taken. The Department of Statistics conducted a series of pilot censuses during the year. As a test of administrative machinery these were encouraging. The results suggested that the actual population of the Sudan may be appreciably higher than the figures hitherto arrived at in official estimates.

TABLE V.
Estimated population of provinces.

PROVINCE			Men	Women	Children	Total
Bahr El Ghazal ...	...	...	270,032	335,067	449,859	1,054,958
Blue Nile	...	...	546,896	662,050	853,425	2,062,371
Darfur	...	...	229,860	357,062	475,201	1,062,123
Equatoria	...	...	171,961	220,914	307,266	700,141
Kassala	...	...	242,493	236,850	329,840	809,183
Khartoum	...	...	157,369	150,873	148,600	456,842
Kordofan	...	...	480,988	608,370	941,920	2,031,278
Northern	...	...	199,662	267,486	348,048	815,196
Upper Nile	...	...	174,621	236,598	351,012	762,231
TOTAL	...	...	2,473,882	3,075,270	4,205,171	9,754,323

TABLE VI.
*Estimated population of towns of Khartoum,
Khartoum North, Omdurman.*

TOWN		Men	Women	Children	Total
Khartoum	...	34,048	27,375	29,664	91,087
Khartoum North	...	16,754	15,021	22,225	54,000
Omdurman	...	36,123	46,746	53,200	136,069

It is probable that in the above towns most births are attended by trained midwives. These keep records of the number of births attended and register them with the local registrars. Table VII shows the crude birth rates calculated from such registrations. Registration of deaths is probably nowhere complete.

TABLE VII.
*Crude birth rate.
Khartoum, Khartoum North, Omdurman.*

TOWN		No. of registered Births	Crude birth rate
Khartoum	...	2,425	26.6
Khartoum North	...	1,315	24.4
Omdurman	...	4,024	29.6

(d) PREVENTIVE MEDICINE.

1. Insect-borne Diseases.

(i) *Malaria.* Residual imagocidal spraying was again widely used in rural areas. Most of the northern provinces reported some decrease in recorded incidence of malaria. The mean of the rainfall measured at meteorological stations in northern provinces was generally higher than that of 1952/53. On the widely held belief that incidence of malaria in the northern provinces is directly correlated with the amount of rainfall it might have been expected that the incidence in 1953/54 would have been higher than that of the year before. However, it cannot be claimed that there is valid statistical evidence in support of a view that residual spraying has reduced malaria throughout rural areas generally in the north.

There was certainly some variation in the efficiency with which spraying was done in different districts. The administrative machinery has been most thoroughly worked out, and is most easy of application, in the compact, thickly populated and comparatively well staffed Gezira Irrigated Area. It is only in this area that it has been practicable to attempt a numerical measurement of the effectiveness of residual spraying.

During each of the past three years practically all rooms in the Gezira Irrigated Area have been sprayed twice in the season with B.H.C. (Gammexane P. 520) at a calculated dosage of 10 mgms. of the gamma isomer per square foot. Since the season 1950/51, when residual spraying was not done, figures of attendances diagnosed as malaria at the same 24 dispensaries serving a part of the area are available. They are shown below :—

YEAR								No. of cases diagnosed malaria	Recorded rainfall
1950/51	...	...	...	...	...	...	...	20,684	327.3 mm.
1951/52	...	...	...	...	...	...	...	4,336	255.6 mm.
1952/53	...	...	...	...	...	...	...	4,351	414.4 mm.
1953/54	...	...	...	...	...	...	...	3,528	338.5 mm.

Population may be assumed to have increased during these years. It appeared that, since introduction of residual spraying, the incidence of diagnosed malaria has fallen to less than one-fifth of the figure before spraying.

Managil district adjoins the western part of the Irrigated Area. Houses in this district were not included in the residual spraying project. Rainfall was sharp and malaria assumed epidemic proportions. Conditions furnished a notable contrast to the comparatively low level of malaria in the Irrigated Area. An emergency residual spray campaign, combined with treatment of cases by travelling staff, were followed by subsidence of the epidemic.

Owing to the density of population and the economic importance of the Gezira Irrigated Area a measure of larval control was practised in addition to adult control. The responsibility for larval control was placed upon the tenants. Before it has been required of a tenant to bale dry irrigated channels after watering. Following

earlier trials compulsory baling was largely substituted by oiling of water remaining in the field channels. Oiling is more popular with the farmers than baling and it avoids the disadvantage of entering the water. Oiling through the agency of tenants was adjudged successful providing co-operation was gained and close supervision was maintained.

The extent of adult control campaigns undertaken during the season was :—

BLUE NILE PROVINCE.

Gezira Irrigated Area: Approximately all (222,650) rooms sprayed twice. Managil district: 2650 rooms sprayed. Wad Medani town: Perimeter spraying, 3653 rooms. Fung area: 11,582 rooms. Ed Dueim district: 177,805 rooms. Kosti district: 126,260 rooms.

DARFUR.

Towns of El Fasher, Nyala, Geneina, Zalingei and Kuttum sprayed twice. Mellit, Daein, Buram, Um Kedada and Kebkebiya villages sprayed once.

KASSALA.

14,301 rooms in Kassala and 13,941 in Gedaref were sprayed twice. Aroma and Waggar sprayed once. Perimeter spraying was done in Tendelai, Degein, Makali and Mitataib.

KHARTOUM.

Over 50,000 rooms in the rural district were sprayed twice and a half of them were sprayed a third time.

KORDOFAN.

All towns and large villages were sprayed.

NORTHERN.

Riverain villages of both banks from the southern border to Abu Hamad treated twice.

In the southern provinces towns and large villages were treated.

The Medical Inspector, Northern Fung, arranged a sample survey in 55 villages on both banks of the Blue Nile between Sennar and Singa. The survey was done in January and April, the dry season. The splenic index in 3,330 children examined was just over 24 per cent. There was no significant difference in the index in the various areas covered by the survey. There was some indication that *A. rufipes*, as well as *A. gambiae*, may be an important malaria vector in this district.

TABLE VIII.

Species of parasite in 10,692 positive slides.

PROVINCE		<i>P.falciparum</i>	<i>P.vivax</i>	<i>P.malariae</i>
Bahr El Ghazal	...	1,085	31	—
Blue Nile	...	1,272	93	—
Darfur	...	283	154	—
Equatoria	...	3,916	218	34
Kassala	...	1,109	79	1
Khartoum	...	345	42	—
Kordofan	...	1,516	157	—
Northern	...	112	24	—
Upper Nile	...	216	5	—
TOTAL	...	9,854	803	35

(ii) *Blackwater fever.* This disease has for some years not been of serious significance. 3 cases were admitted to hospital, of which 1 died.

(iii) *Relapsing Fever.* Two moderate outbreaks were reported. In Talodi district in March the focus of infection was believed to be in workers in the ginning factory. Prompt delousing of the ginning factory staff was followed by complete abatement of the epidemic by May. There was a total of 34 cases, with 3 deaths. 3 cases, apparently connected with Talodi epidemic, were discovered at Kadugli and Um Ghulfan. 53 cases with 4 deaths were reported in Geneina and Zalengei districts of Darfur. Recorded incidence of relapsing fever in the past 10 years has been :

TABLE IX.

Relapsing fever : cases and deaths over 10 years.

YEAR	Cases	Deaths
1944	22,672	310
1945	17,392	444
1946	1,952	65
1947	568	67
1948	287	8
1949	376	3
1950/51	36	2
1951/52	12	0
1952/53	97	14
1953/54	91	8

(iv) *Leishmaniasis.* Cases were recorded in all provinces except Northern Province and the Bahr El Ghazal. 603 cases were admitted to hospital in the northern provinces, of which just over 82 per cent were received in the three hospitals of Gedaref, Singa and Sennar. No record was made of the probable origin of infection of cases admitted to other northern hospitals. Infection in Equatoria again appeared to be confined to Kapoeta district. There was a further slight fall in the recorded incidence in Melut-Paloic area of Upper Nile Province.

There was a sharp rise in the recorded incidence in Gedaref district. The Province Medical Officer of Health started an epidemiological study of the disease. The increased number of cases may not have been unassociated with increased interest. It was attempted to pinpoint the origin of infection of every case in the hope that detailed examination of natural factors may throw more light on the causation of infection and show a way to control of transmission.

There was probably increased incidence, and possibly northward extension, of kala azar in the northern Fung district. In this connection the report of the Medical Entomologist of a greater frequency of *P. lesleyae* in Sennar area may be significant.

Results of treatment with Sodium stibogluconate were comparatively good as long as patients reported relatively early. There was no record of the incidence of re-infection with kala azar in patients cured of the disease. No figures of age-distribution of cases were published, but it appeared that a majority of cases were in children.

TABLE X.
Leishmaniasis: recorded incidence in 10 years.

YEAR							No. of Cases.
1944	...	...	...	...	...	...	205
1945	...	...	...	...	...	...	192
1946	...	...	...	...	...	...	246
1947	...	...	...	...	...	...	327
1948	...	...	...	...	...	...	460
1949	...	...	...	...	...	...	523
1950/51	...	...	...	...	...	...	638 (18 months period)
1951/52	...	...	...	...	...	...	1,063
1952/53	...	...	...	...	...	...	613
1953/54	...	...	...	...	...	...	895

TABLE XI.
Leishmaniasis, 1953/54 : distribution by provinces.

PROVINCES					Cases	Deaths
Blue Nile	...	...	...	...	391	24
Darfur	...	...	...	...	7	0
Equatoria	...	...	...	...	55	6
Kassala	...	...	...	...	296	31
Khartoum	...	...	...	...	13	0
Kordofan	...	...	...	...	3	0
Upper Nile	...	...	...	...	130	11
TOTAL	...	...	...	...	895	72

(v) *Trypanosomiasis*. There was a further increase in new cases discovered in Yambio and Yei districts. Incidence in chiefships near Yambio and Li Rangu was estimated as 4 per 1000. Infected cases were found along many major and

minor tributaries of four main rivers. Full scale fly control was not considered practicable. A scheme for mass prophylaxis with Pentamidine was formulated and is under consideration. It was considered that small fly control schemes in selected areas should be associated.

There has been an upward trend in the number of cases discovered in Yambio district over the past 4 years, but the total in 1953/54 is the largest recorded in any district since 1924, when 203 cases were reported in Li Yubu district. The number of new cases in Yei district was the greatest recorded in the area since 1913.

No case was found in Meridi district, but in view of the raised incidence in Yambio district it was decided to intensify inspections from Meridi.

2 cases were recorded as discovered in Li Yubu district in 1952/53, but subsequent investigation showed them to have been imported into the district. This district has yielded no new cases for 3 years. 83 old cases were under observation. 12 old cases not previously recorded were found during the year.

The detected incidence in the province over the past 10 years has been:

TABLE XII.

Trypanosomiasis : distribution of cases in Equatoria in 10 years.

YEAR	Yubu	Yambio	Yei	Kajo-Kaji	Meridi	Imported	Other Localities
1944	37	—	35	—	4	—	4
1945	16	1	19	—	—	—	3
1946	21	19	16	—	—	—	—
1947	18	6	21	—	2	—	—
1948	32	23	20	—	—	—	—
1949	5	12	17	—	—	—	—
1950/51	15	33	12	—	—	—	1
1951/52	—	93	3	—	26	—	—
1952/53	—	53	13	—	—	2	—
1953/54	12	148	44	—	—	—	—

(vi) *Filariasis.* 381 of 452 cases recorded were in the two southern provinces. Of 181 positive slides examined in Wau Hospital 126 showed *Mf. perstans* and 55 *Mf. loa loa*.

2. EPIDEMIC AND ENDEMIC DISEASES.

(i) *Anthrax.* 8 cutaneous cases treated in Singa Hospital were directly traced to an outbreak of cattle anthrax. Sporadic cases were reported in Darfur. The disease occurred relatively often amongst the cattle-loving people of the Upper Nile Province. Results of treatment with combined arsenicals, sulphonamides and penicillin were uniformly good.

(ii) *Cerebrospinal meningitis.* The infection remained endemic with a fairly heavy scattered incidence in the northern provinces, with Kordofan, Darfur and the Blue Nile provinces most severely affected. The epidemic cycle of menin-

gococcal meningitis in the Sudan which has become familiar ran according to pattern with a severe continuance of the epidemic in the Bahr El Ghazal and, at a less intense pitch, in the Upper Nile Province.

The epidemic in the Bahr El Ghazal mainly occurred in the months January to April. During this period there were 6,906 cases of a total of 7,412 notified during the whole year. The main foci of infection were in Aweil and Gogrial districts. Over 90 per cent of all cases in the province were in these areas. Deaths in the reported cases numbered 550, a fatality rate of 7.4 per cent. It was noted that, apart from a small number who succumbed to a fulminating infection, death was usually due to delay in seeking treatment. The recovery rate for cases brought for treatment within 48 hours of the onset of symptoms approached 100 per cent.

A standardised routine treatment using sulphathiazole exclusively, was adopted. A suspension, prepared in Wau Hospital, was issued to treatment centres for injection and for oral administration to infants. Tablets were supplied for older patients. Undoubtedly some patients were given unnecessary injections, but this was judged preferable to placing too much reliance on the clinical acumen of dressers in charge of treatment centres.

A limited plan of chemoprophylaxis, using sulphathiazole, was operated. A single prophylactic dose, graduated according to age, was given to :

- (i) all persons bringing a case to a treatment centre ;
- (ii) all members of a homestead from which a case was collected ;
- (iii) all inhabitants of the sizeable population aggregations of Aweil, Gogrial, Tonj and Nyinakok.

It was not possible under the conditions of the epidemic to attempt any statistical measurement of the effectiveness of this plan.

The outbreak in Upper Nile Province totalled 669 discovered cases, mainly in the early months of 1954. There were 109 deaths.

TABLE XIII.
Cerebrospinal meningitis : recorded incidence and fatality, 1953/54.

PROVINCE					Case	Deaths	Fatality rate
Blue Nile	...	...	...	...	183	43	23.5
Darfur	...	...	...	...	176	17	9.6
Kassala	...	...	...	...	63	21	33.3
Khartoum	...	...	...	...	23	0	0
Kordofan	...	...	...	...	379	77	20.3
Northern	...	...	...	...	22	8	36.4
Total : Northern Provinces					846	166	19.6
Bahr El Ghazal	...	...	...	...	7,412	550	7.4
Equatoria	...	...	...	...	15	2	13.3
Upper Nile	...	...	...	...	669	109	16.3
Total : Southern Provinces					8,096	661	8.2
Overall total					8,942	827	9.2

TABLE XIV.
Cerebrospinal meningitis : recorded incidence and fatality over 10 years.

YEAR							Recorded cases	Recorded deaths	Fatality rate
1944	...	...	...	...	...	...	2,346	405	17.3
1945	...	...	...	...	...	...	6,166	666	10.8
1946	...	...	...	...	...	...	730	155	21.2
1947	...	...	...	...	...	...	443	159	35.9
1948	...	...	...	...	...	...	170	59	34.7
1949	...	...	...	...	...	...	353	102	28.9
1950/51 (18 months)	...	...	...	...	...	...	57,575	7,710	13.4
1951/52	...	...	...	...	...	...	14,527	2,031	14.0
1952/53	...	...	...	...	...	...	2,938	644	21.9
1953/54	...	...	...	...	...	...	8,942	827	9.2

(iii) *Diphtheria.* Culture diagnosis is generally only practicable in Khartoum. There must be a measure of reserve in acceptance of some of the records.

TABLE XV.
Diphtheria : recorded incidence and fatality, 1953/54.

PROVINCE						Recorded cases	Recorded deaths	Fatality rate
Bahr El Ghazal	...	...	...	...	...	0	0	—
Blue Nile	...	...	...	...	...	56	10	17.8
Darfur	...	...	...	...	...	10	0	—
Equatoria	...	...	...	...	...	4	1	25.0
Kassala	...	...	...	...	...	20	3	15.0
Khartoum	...	...	...	...	...	115	5	4.3
Kordofan	...	...	...	...	...	75	6	8.0
Northern	...	...	...	...	...	51	2	3.9
Upper Nile	...	...	...	...	...	4	0	—
TOTAL	...	...	...	...	...	335	27	8.1

TABLE XVI.
Diphtheria : recorded incidence and deaths in 10 years.

YEAR								Cases	Deaths
1944	...	...	...	...	...	...	...	270	61
1945	...	...	...	...	...	...	...	389	54
1946	...	...	...	...	...	...	...	390	61
1947	...	...	...	...	...	...	...	319	37
1948	...	...	...	...	...	...	...	326	27
1949	...	...	...	...	...	...	...	264	36
1950/51 (18 months)	...	...	...	...	...	...	...	573	77
1951/52	...	...	...	...	...	...	...	280	30
1952/53	...	...	...	...	...	...	...	717	37
1953/54	...	...	...	...	...	...	...	335	27

(iv) *Dysentery*. It has not been attempted to differentiate in the records between amoebic and bacillary dysentery. Accurate diagnosis was not possible in the conditions under which many cases were treated. There was a slight rise in the number of cases diagnosed and in the number admitted to hospital. It may be only the more severe cases that gained entry to the records.

(v) *Enteric fever*. Despite a further fall in the number of notifications in Khartoum Province the overall admissions to hospital showed little decrease. The fall in incidence in Khartoum Province may have been in part due to the massive T.A.B. inoculation project undertaken in Omdurman during the previous year. However, the disease is more than lightly endemic in Blue Nile, Khartoum and Northern provinces. Incidence was generally spread over the year with a tendency to peak during the rains when the risk of fly transmission was probably at a maximum. There were limited explosive outbreaks at Wadi Halfa, Dongola, Atbara, Abu Usher and Ed Dueim. In no instance was it possible to trace the origin of the outbreak. At Ed Dueim suspicion was cast upon wells believed to have been contaminated through seepage following the rise of river level.

It is probable that the increase in enteric infection may be associated with rapid growth of urbanisation and the heavy strain on sometimes primitive sanitation and cleansing systems. Greater facility of communications may have added to the risk of spread of infection. The existence of foci in the Gezira Irrigated Area and the discovery of a focus at El Geili village, 31 miles from Khartoum, may have illustrated this supposition.

The overall fatality rate was 7.5 per cent. This relatively low figure may have in part been due to treatment with chloromycetin.

TABLE XVII.
Enteric fever : distribution, 1953/54.

PROVINCE	Cases	Deaths
Bahr El Ghazal	7	0
Blue Nile	99	6
Darfur	7	1
Equatoria	28	1
Kassala	29	1
Khartoum	134	8
Kordofan	6	0
Northern	238	24
Upper Nile	12	1
TOTAL	560	42

TABLE XVIII.
Enteric fever : incidence over 10 years.

YEAR	Recorded cases
1944	199
1945	183
1946	116
1947	144
1948	202
1949	311
1950/51 (18 months)	560
1951/52	578
1952/53	598
1953/54	560

(vi) *Gastro-enteritis of children.* The fatality rate in 875 cases admitted to hospital was just over 10 per cent. 49,377 were recorded in out-patient units, of which over 85 per cent were in Khartoum, Blue Nile and Northern Provinces.

(vii) *Leprosy.* The results of a survey done by a lay worker of BELRA in Central District of Equatoria during 1951/52 and 1952/53 became available. Over 27,000 persons were examined. The incidence of leprosy was 44 per 1000. This may be compared with the figure of 52 per 1000 reported by Abbott amongst the Azande and that of 20 per 1000 resulting from a less extensive BELRA survey in the Moro district. The Medical Officer, Li Yubu, considered that the incidence in the district was as high as 65 per 1000.

The total number of lepers in settlements in Equatoria was 1329. This figure was less than 12 per cent of the total known lepers in the province, while the surveys indicated that the actual number of cases in the province is certainly greater than the total known cases.

A majority of cases of leprosy in Equatoria is of neural type. In the Central District survey only 10.2 per cent of cases were classified lepromatous. Symptoms in the neural cases are often mild and the disability suffered is not very grave. A large number of such cases may become spontaneously "burnt-out."

Though perhaps of less degree of infectivity than lepromatous cases, for at least a part of the course of the disease cases of nerve leprosy are capable of transmitting infection. There is very little fear of the infectivity of leprosy in Equatoria and practically no social ostracism of the leper. The leprosy patient whose symptoms and disability are minimal will not willingly accept immurement in leper settlements. This apart, the very size of the problem makes its solution through a policy of segregation, voluntary or compulsory, of doubtful practicability. Even were it accepted in principle it is considered that there are a number of outstanding health problems with a greater priority of claim on available resources than any extension of leprosy settlements.

Treatment with sulphone drugs has given promising results. The drug has won public favour and patients have shown increasing readiness to attend out-patient centres for regular supplies of medicine and inspection. It appeared that a system of combined out-patient and domiciliary supervision and treatment offered the most promising line of advance towards an abatement of the problem of leprosy.

Leprosy, as most other ailments that afflict the Sudan, is a social disease. It is on social and economic betterment that a permanent solution of the leprosy problem depends.

Adequate supplies of sulphone were made available in the dispensary and dressing stations of the Ingessana Hills. 189 cases of leprosy were registered in these treatment centres. Of these, 60 per cent were persuaded to attend regularly at monthly intervals for inspection and issue of a supply of sulphone. In this area it is probable that a majority of cases are of the lepromatous type. The therapeutic response was generally encouraging.

(viii) *Poliomyelitis.* 2 acute cases were diagnosed in Khartoum Province and 1 each in Darfur, Equatoria and Northern Provinces.

(ix) *Rabies*. 39 cases of human hydrophobia were recorded. Rabies was diagnosed by brain examination in 83 animals. Immunisation of a small number of dogs was done in Khartoum.

(x) *Smallpox*. The epidemic which started in Darfur in 1951 was not finally controlled. Cases continued to occur in most districts of the province throughout the year. The recorded total was 1767 cases with 221 deaths, fatality rate 12.5 per cent. These figures compare with 3653 cases and 578 deaths in the previous year. Since the start of the outbreak in September, 1951, the cases reported have been 5,613 with 817 deaths.

There are many explanations for the difficulty in controlling the epidemic. Shortage of supervisory staff; transport limitations and relative inaccessibility of much of the population, particularly during the rains; the nomadic habit of large sections of the people; large numbers of wandering Mohagreen. The Province Medical Officer of Health considered that there is still a widespread desire to evade vaccination and much delay in reporting, or actual concealment of, cases. The old customs of protective inoculation from cases of the disease has not been stamped out and helped to maintain the infection.

431,554 vaccinations were done during the year. According to the number of vaccinations done since appearance of the first cases each person of the estimated population of Darfur has been vaccinated 1.32 times, though it is probable that some of the records of numbers of vaccinations done are inaccurate. It appeared that the percentage of successful vaccinations was unsatisfactory. This may have been partly due to imperfect techniques of inexperienced operators, but perhaps largely to deterioration of the vaccine lymph owing to defective storage caused by the transport problems of Darfur.

The disease was believed to have spread from Darfur into Kordofan and it is probable that an almost simultaneous spread occurred into the latter province from the Bahr El Ghazal. Small outbreaks occurred early in October, 1953, in El Obeid, El Odaya and Muglad. Investigation indicated that the disease had been present, undiscovered and unreported, since before the rains. Introduction was possibly due to contact between the Dinka of Abyei and the Dinka of Aweil.

Late in October cases were discovered at Ghibeish. Here the infection appeared clearly traceable from Darfur. Cases of smallpox occurred subsequently in Northern Kordofan and in the Nuba area. The total number of cases reported in Kordofan was 171, with 19 deaths. Orthodox control measures were instituted. Tracing of the source of infection, isolation of cases and contacts, vaccination of all believed to have been exposed to infection and terminal disinfection. Mass vaccination was undertaken in Nahud, Abu Kershola and Um Inderaba areas. Simultaneously mass vaccination was carried out in the western part of Khartoum Province. The total number of smallpox vaccinations done in Kordofan was 226,376.

In addition to its burden of cerebrospinal meningitis the Bahr El Ghazal was attacked by an epidemic of smallpox. The first cases were noted in the north-east part of Aweil district in September, 1953. The major weight of the epidemic fell on Aweil and Gogrial districts, but in May a relatively severe outbreak developed in Western District. The total number of cases reported in the Bahr-El Ghazal was 1,013, with 172 deaths, but the outbreak had not abated at the end of June and control measures were further handicapped by the rains.

237,345 vaccinations were done in the Bahr El Ghazal, but a check survey carried out indicated that only about 40 per cent gave successful "takes." The same factors as have been described in Darfur probably operated here. Unwillingness of much of the population to undergo vaccination and active and ingenious concealment of cases may be at a maximum in the Bahr El Ghazal. Co-operation of chiefs and sub-chiefs appeared sometimes languid. The local therapeutic habit of evacuating the contents of every pustule with a thorn proved difficult to check in some of the improvised isolation centres and is extremely conducive to dissemination of infection.

Including those in the provinces mainly attacked over 1½ million vaccinations were recorded throughout the country.

(xi) *Tuberculosis.* International staff, consisting of 1 doctor and 1 nurse, of the World Health Organisation started work on a B.C.G. vaccination project in March, 1954. The material commitment of the Organisation has been financed by the United Nations Children Fund. The international staff has been suitably matched by national staff. The initial phase of the project is a wide sample survey throughout the Sudan by means of the Mantoux test. Negative reactors were vaccinated. From the information derived from the survey it is intended to plan an extensive campaign of immunisation as the second phase of the project.

Preliminary arrangements for the project had gone smoothly. The team was able to start work with no loss of time. Some public opposition was surprisingly met with in Khartoum Province. It was due to a cleverly timed propaganda campaign apparently launched by a foreign scientist whose opinion is adverse to the use of B.C.G. vaccine. The team was at once diverted to the second stage of a prearranged programme and started a survey in the southern provinces. Local health education machinery was brought to bear to counteract the effect of the adverse propaganda. The southern survey was going well at the end of June.

TABLE XIX.

Tuberculosis : admissions to hospital in 10 years.

YEAR	Pulmonary	Non-Pulmonary	Total
1944	796	632	1,428
1945	957	643	1,600
1946	888	613	1,501
1947	877	599	1,476
1948	1,019	604	1,623
1949	1,176	650	1,826
1950/51 (18 months)	1,611	883	2,494
1951/52	1,325	747	2,072
1952/53	1,679	671	2,350
1953/54	2,075	798	2,873

Admissions to hospital did not represent the full diagnosed incidence of tuberculosis. Many cases were referred for domiciliary care. It was increasingly being grasped that domiciliary care must be a major weapon against the disease.

TABLE XX.
Tuberculosis 1953/54. Hospital admissions by provinces.

PROVINCE	Pulmonary	Non-Pulmonary	Total
Bahr El Ghazal	117	57	174
Blue Nile	315	139	454
Darfur	72	32	104
Equatoria	190	48	238
Kassala	391	172	563
Khartoum	425	117	542
Kordofan	219	71	290
Northern	237	106	343
Upper Nile	109	56	165
TOTAL	2,075	798	2,873

(Note : figures for pulmonary tuberculosis in Khartoum are weighted by cases from other provinces coming for specialist advice).

The total number of cases diagnosed is shown in Table XXI. Some of the diagnoses in rural areas were made without radiological or bacteriological examination and may be questionable.

TABLE XXI.
Tuberculosis, 1953/54 : distribution of all cases diagnosed.

PROVINCE	Pulmonary	Non-Pulmonary	Total
Blue Nile	392	606	998
Darfur	119	82	201
Kassala	509	524	1,033
Khartoum	757	567	1,324
Kordofan	400	205	605
Northern	434	209	643
Total Northern Provinces	2,611	2,193	4,804
Bahr El Ghazal	181	62	243
Equatoria	233	52	285
Upper Nile	180	202	382
Total Southern Provinces	594	216	910

The diagnosed incidence per 1000 of the estimated population was :—

Northern Provinces	...	...	...	0.65
Southern Provinces	...	...	...	0.38

The upward trend of recorded cases of tuberculosis was paralleled by the general increase of work done in medical centres. The number of admissions was partly governed by the number of beds available. Advent of more hopeful lines

of treatment has led more sufferers to seek medical care. Possession of more powerful therapeutic weapons has undoubtedly stimulated clinical interest. Yet the newer drugs were not without danger. There is a risk that their indiscriminate use may give rise to strains of resistant organisms.

As previously noted pulmonary and non-pulmonary tuberculosis was predominantly found in early and middle adult life. Cases in infancy and childhood were comparatively rarely diagnosed. Examination of contacts at Khartoum Chest Centre disclosed only 5 cases of pulmonary tuberculosis in children.

TABLE XXII.
Tuberculosis : age-distribution of 2502 cases.

	AGE PERIODS							Over 65	Unde-fined.
	0-1	1-5	6-15	16-25	26-35	36-45	46-65		
<i>Northern Provinces.</i>									
Pulmonary	3	9	46	330	469	294	215	30	—
Non-Pulmonary ...	10	28	107	125	173	88	52	11	—
<i>Southern Provinces.</i>									
Pulmonary	1	9	21	62	85	96	32	5	20
Non-Pulmonary ...	5	13	13	33	33	21	8	—	—
<i>Non-Sudanese.</i>									
Pulmonary ...	—	1	—	—	15	13	5	5	—
Non-Pulmonary ...	—	—	—	4	6	2	3	1	—

TABLE XXIII.
Site of main lesion in 736 cases of non-pulmonary tuberculosis.

Site of Lesion	Northern Provinces	Southern Provinces	Foreigners	Total
Gland	213	56	2	271
Bone	189	47	9	245
Joint	81	15	2	98
Abdomen	47	7	—	54
Skin	21	—	3	24
Genito-urinary	13	—	—	13
Meninges	31	—	—	31
TOTAL	595	125	16	736

KHARTOUM CHEST CENTRE.

The staff of the unit was 2 physicians and 7 tuberculosis visitors, with the necessary nursing staff in hospitals. The former isolation hospital in Omdurman was re-conditioned and, as Abu Anga Chest Hospital, provided 96 beds for

tuberculosis, bringing the total beds available in the Three Towns to 189. Outpatient tuberculosis centres were operated regularly in Khartoum and Omdurman.

1,454 cases of pulmonary tuberculosis were diagnosed in the Chest Unit, compared with 1,259 the year before. The figure included cases referred from other hospitals.

Case-finding at the out-patient centres included a wide measure of supervision of contacts. A number of early cases suitable for treatment were found amongst them.

Three cases of manifest pulmonary tuberculosis occurred in students of the University College of Khartoum. 431 other students of the College were subsequently tuberculin tested. 272 were Mantoux positive, a conversion rate of 63.1 per cent. 170 of the positive reactors were examined by X-rays, with the following result :—

Normal	...	...	...	...	...	...	139
Calcified primary foci	...	...	...	...	...	...	13
Calcified foci of re-infection type	...	...	...	...	...	...	5
Pleural changes	...	...	...	...	...	...	3
Doubtful shadows referred for follow-up	...	...	...	...	...	...	6
Abnormalities, non-tuberculous	...	...	...	...	...	...	4

Domiciliary care has become established as an important and effective means of treatment and prevention of tuberculosis in Khartoum urban areas. It was becoming accepted by patients and their families and there was growing readiness to observe a regime. Success of domiciliary treatment was much dependent upon the diligence and efficiency of tuberculosis visitors. Rest in bed and a combination of P.A.S. and Isoniazid was the usual line of treatment. Streptomycin was usually reserved for selected cases in hospital. 188 cases were under domiciliary care at the end of the year. The results of domiciliary treatment were judged to be encouraging and to compare favourably with those obtained in institutions.

The following is a summary of work done by the Chest Centre :—

Cases under domiciliary care at 30.6.1954	...	...	...	...	...	188
Admissions to hospital	...	...	...	...	...	368
Discharged from hospital	...	...	...	...	...	265
(a) Quiescent and fit for light work	...	...	...	...	...	218
(b) Transferred to other institutions or sent home as unlikely to benefit from residential treatment	...	...	...	...	...	344
(c) Lost trace	...	...	...	...	...	13
Died in hospital	...	...	...	...	...	39
No. of out-patients seen	...	...	...	...	...	3,332
(a) Pulmonary tuberculosis	...	...	...	...	...	1,454
(b) Non-pulmonary tuberculosis	...	...	...	...	...	180

(c) Non-tuberculous chest conditions and suspects under surveillance	...	...	...	...	...	...	...	1,698
New contacts examined	...	...	...	...	...	...	...	1,113
Contacts under surveillance at 30.6.1954	...	...	...	...	...	...	...	1,795
Tuberculin tests	...	...	...	...	...	...	...	920
Home visits by tuberculosis visitors	...	...	...	...	...	...	...	2,920
Screening examinations	...	...	...	...	...	...	...	4,320

The Sudan Association for Prevention of Tuberculosis continued to give worthy help. The aid given by the Association has contributed much to the success of domiciliary care. £E. 1320 was disbursed in home aids for tuberculous patients. The Association arranged printing and distribution of an instruction pamphlet for use in the homes of tuberculous patients.

The British Red Cross Association and the Egyptian Red Crescent Association agreed to co-operate with the Sudan Association for Prevention of Tuberculosis in a scheme for diversional handicrafts and re-habilitation training for tuberculous patients.

(xii) *Undulant Fever.* 34 cases were spread over all provinces except the Bahr El Ghazal.

3. HELMINTHIC DISEASES.

(i) *Ancylostomiasis.* 8,205 of 8,830 cases reported were in the two southernmost provinces.

(ii) *Dracontiasis.* 3,568 cases were reported. Equatoria, the Bahr El Ghazal and Kordofan were the main centres of infection.

(iii) *Schistosomiasis.* The biologist appointed to the Schistosomiasis Research Unit in the Gezira Irrigated Area continued to work until the end of 1953. He formed two significant conclusions. He agreed with the work previously done showing that sulphation, using a dosage of 30 parts per million of copper sulphate throughout all irrigation channels was successful in destroying all snails in the channels. He showed that snails could be prevented from re-entry to the channels by means of suitable traps placed across the mouths of major and minor canals. The traps were made with a grid framework of iron rods, closely interlaced with palm leaves.

These traps gave rise to objections from the Irrigation Department on the grounds that they seriously interfered with the water flow. Concurrently with the trials of the traps further trials were made by suspending a number of bags containing copper sulphate across the mouths of the major and minor canals. The quantity of copper sulphate in the bags dissolved in 24 hours and gave a calculated dosage of 0.125 parts per million to the water entering the channels. This method of continuous sulphation was kept under observation up to the end of June, thus including the season of maximum snail breeding, and it appeared to be completely successful in preventing re-entry of snails into the irrigation system. The method of continuous sulphation is more expensive than the use of traps. It is more easily administered, does not involve staff entering the water and has the great advantage that it does not retard the rate of water flow.

In principle, it was decided that a long term trial of snail control throughout the Gezira Irrigated Area was justified by the results of the preliminary experimental work and the gravity of the schistosomiasis problem. It was considered that the trial should consist of an initial sulphation at a dosage of 30 parts per million in all channels. This should be followed by the immediate institution of continuous sulphation, using 0.125 parts per million, of all major and minor canals in the scheme.

The World Health Organisation was asked to send experts to comment and criticise this project, but the report had not been received by the end of the year.

The cost of the project is formidable. It was estimated that the cost of initial sulphation would be £E. 130,000 and the annual recurrent cost of continuous sulphation would be £E. 50,000.

Schistosomiasis is a serious menace to irrigated agriculture throughout the Sudan and throughout the southern provinces. Results obtained from preventive work in the Gezira Irrigated Area may have significant application over the country.

Ten cases of urinary bilharzia were found in school children of Khogalab village, Khartoum Province. A survey of 13 villages and pump schemes was done with the following results :—

					No. examined	No. infected
Men	...	...	...	...	2,071	107
Women	...	...	...	...	184	13
Children	...	...	...	...	1,657	180
	TOTAL			...	3,912	300

All cases were infections with *S. haematobium*.

E. SANITARY CIRCUMSTANCES.

Water supplies. A first instalment of a piped water supply to Wau town was completed. A report from the Stack Laboratories commented "an excellent water supply." Further "Anti-guinea-worm" tops to wells were constructed throughout the Bahr El Ghazal.

17 deep bore wells were in use in the Gezira Irrigated Area. It was anticipated that the number would shortly be 50.

Progress was made with the water purification installation at El Fasher and a purified water supply next year was predicted. Continued advance was made in the well-boring and hafir-digging programme in Darfur and Kordofan.

Construction of a dam designed to impound water for Meridi was started. Water supplies at Li Yubu, Li Rangu and Yei caused anxiety in the dry season. Juba experienced scarcity in the dry season and the purification plant developed defects. It became necessary to transport water to Luri Rokwe Leper Settlement.

Work started on a piped water supply project in the Gash area. There was some extension of the purified water supply in Port Sudan. The relatively small bore of some of the earlier mains proved a limiting factor.

Daily bacteriological investigation of the water supply of the Three Towns indicated that the purification process was satisfactory.

Provision of new sources of water for El Obeid barely kept pace with the increased demand.

Refuse disposal. Tipping and open burning remained the method of choice. It was often usefully adopted to filling in depressions in the environs of towns or villages. Introduction of street orderlies was a successful venture in Rumbek. Certain Local Government Authorities in the Gezira showed a gratifying interest in village cleanliness. Refuse clearance service was mechanised in Nahud.

Sewage disposal. Disposal of human waste matter remained a problem for solution. Systems generally in use included :—

(a) *Pail conservancy.* This is extremely expensive and the expense increases proportionately with the size of the area served. The contents of buckets are exposed to flies during the day, with risk of spread of infection. Fly eggs deposited in the buckets breed out after burial of the contents. It becomes more difficult to engage labour for this noisome work.

(b) *Deep pit latrines.* Not all soils are suitable. A high water table level may cause danger of contamination of adjacent wells. Fly-breeding takes place in a large number of pit latrines. Ill-advised attempts at control of fly breeding by insecticides were an expensive failure and have created an insecticide-resistant strain of flies.

(c) *Auger bores.* Wherever tried these have filled rapidly and have most of the other disadvantages of pit latrines.

(d) *Chemical closets* have not been successful.

(e) *Septic tanks.* These have worked satisfactorily under appropriate conditions.

(f) *Water privy.* This flushless septic tank is cheaper of construction than the orthodox installation and does not pose the same problem of effluent disposal. It is still in the trial stage in the Sudan, but enough experience has been gained to indicate that the water privy is successful as a domestic unit if it is correctly designed and properly made and if it is not subjected to misuse or neglect by the householder. Implicit for success is skilled supervision of design and every stage of construction, adequate testing before the privy is used, a population educated in its proper use. It has seemed that, subject to these provisos, water privies on a wide scale offer the most practicable early hope of improvement in sewage disposal. Over a relatively short term water privies should prove cheaper than bucket systems or pit latrines.

Construction of a main drainage system in Khartoum was continued. A total of 1108 water privies were installed in Atbara under the conversion project.

2 trial water privies worked well in Kamlin. 44 of these privies have been made in Juba. 12 water privies in Kassala were adjudged a success. It was adopted as the type latrine in the developing township of Fula, Kordofan. The trial communal water privy in Malakal, where it was practicable to control the number of users to prevent overcrowding, was markedly successful.

Housing and Town Planning. Private building activity was considerable in most parts of the country. A village re-planning project in the Gezira Irrigated Area was getting slowly under way. As a demonstration the Province Medical Officer of Health produced, in consultation with the residents, a model layout for the re-planning of Wad Mattar village. A section of El Fasher was destroyed by fire. The opportunity was taken of improving the layout of the area before re-building. The re-planning scheme in Kassala progressed satisfactorily. Khartoum Deims slum clearance scheme was completed. Re-development of Morada section of Omdurman was finished and a further section of the town was selected for clearance and re-development. Overcrowding in El Obeid consequent upon the drift of the rural population to the town was acute. A clearance and re-development project was in progress in this town. Re-development of Dakhla area of Atbara was largely completed.

Food in relation to health. Reports from most provinces generally indicated good rains and plentiful food supplies. Attention was drawn to the improved state of nutrition consequent on the prosperity of the Gezira Irrigated Area. However, in the Lakes District of the Bahr El Ghazal the rains were poor and scarcity of grain necessitated import of supplies. Evidence of malnutrition was noted amongst the nomad people of Kassala Province. There appeared to be a considerable degree of iron deficiency anaemia in Gedaref district. Five separate outbreaks of food poisoning, totalling 479 cases with 3 deaths, were reported in Khartoum Province. Milk was incriminated in four outbreaks and meat was regarded as the agent in the fifth. Supervision of foodstuffs and markets was maintained in all larger towns.

Industrial hygiene. Industry in the Three Towns has become increasingly concentrated in defined industrial areas. There was considerable expansion of the industrial area in El Obeid. The sanitary state of the gum cleaning sheds was not satisfactory. There was some tendency to the employment of children under the permitted age in industrial work. A project was initiated in Atbara to remove all factories and workshops from the main market to the industrial area.

CHAPTER IV.
SOCIAL HYGIENE.

Midwifery. Table XXIV shows the midwifery training schools working at the end of the year, date of foundation of each school, total number of midwives trained in the school since opening and the number trained in 1953/54.

TABLE XXIV.

SCHOOL				Date of opening	Total midwives trained since opening	Total trained in 1953/54
Omdurman	...	...	...	1920	736	41
El Obeid	...	...	...	1948	22	4
Juba	...	...	...	1950	12	3
Malakal	...	...	...	1952	6	4
Wad Medani	...	...	...	1953	8	8
				TOTAL	784	60

TABLE XXV.

Distrbution of licensed midwives trained in the Sudan 30.6.54.

PROVINCE	District Midwives	Certificated nurse midwives	Uncertificated nurse midwives	Health visitors	Total
Bahr El Ghazal	...	—	3	1	4
Blue Nile	...	104	9	3	123
Darfur	...	26	2	—	29
Equatoria	...	1	4	—	15
Kassala North	...	9	7	1	19
Kassala South	...	21	2	—	25
Khartoum	...	106	33	1	149
Kordofan	...	55	5	1	66
Northern	...	98	4	3	106
Upper Nile	...	9	2	—	11
TOTAL	...	429	71	25	547

Maternal and Child Health. Four women doctors were engaged in welfare services, at Wad Medani, Juba, Port Sudan and Khartoum. For a part of the year a woman doctor served in El Obeid. Superintendent nursing officers were appointed in all northern provinces. Their duties included supervision of welfare services and district midwives and advice on nursing training in district hospitals. Sudanese health visitors were working in the following stations :—

Khartoum	...	...	...	...	...	3
Omdurman	...	...	...	...	...	4
Khartoum North	...	...	...	...	...	2
Wad Medani	...	...	...	...	...	5
Kosti	...	...	...	...	...	1
El Fasher	...	...	...	...	...	1
Juba	...	...	...	...	...	1
Port Sudan	...	...	...	...	...	2
El Obeid	...	...	...	...	...	1
Atbara	...	...	...	...	...	1

One Sudanese and one British health visitor were seconded to the Ministry of Education for work in the Gezira Adult Education Scheme.

The unit of the Save the Children Fund was withdrawn from Torit towards the end of the year. A woman doctor was posted to Torit Hospital with a view to maintaining the welfare work initiated by the Save the Children Fund staff.

Mainly through the efforts of superintendent nursing officers it was possible to establish a number of simple ante-natal centres in rural areas. Such centres were conducted by district midwives subject to periodic supervision by the superintendent nursing officer. In addition, more elaborate welfare centres were established in the following places :—

	LOCATION		Ante-natal centre	Child health centre
Wau	1	—
Kwajok (Mission)	1	—
Wad Medani	2	2
Hassa Heissa	1	1
Kosti	1	1
Ed Dueim	1	—
Sennar	1	—
Roseires	1	—
El Fasher	1	1
Juba	2	2
Lui (Mission)	—	1
Amadi (Mission)	—	1
Mundri (Mission)	—	1
Torit	—	1
Kassala	4	4
Gedaref	1	1
Port Sudan	4	4
Khartoum	2	2
Khartoum North	2	2
Omdurman	4	4
Khartoum (Rural)	4	4
El Obeid	1	1
Nahud	1	—
Kadugli	1	1
Talodi	1	—
Um Ruaba	1	—
Abu Zabad	1	—
Muglad	1	—
Abri (Mission)	1	1
Heiban (Mission)	1	1
Atbara	2	2
Malakal	1	1

School Medical Service. The number of pupils medically examined was :—

Bahr El Ghazal	...	...	...	...	...	1,071
Blue Nile	...	...	...	...	...	13,845
Darfur	...	...	...	...	...	4,738
Equatoria	...	...	...	...	...	3,425
Kassala	...	...	...	...	...	12,258
Khartoum	...	...	...	...	...	10,488
Kordofan	...	...	...	...	...	3,017
Northern	...	...	...	...	...	22,787
Upper Nile	...	...	...	...	...	1,802
TOTAL	...	...	...	...	73,431	

There was a school dental service only in Khartoum Province. 1922 boys and 2872 girls were inspected. 536 boys and 788 girls required treatment. The school dental surgeon resigned in March, 1954.

Mental Health. The Mental Diseases Board examined 44 cases, classified as follows :—

Schizophrenia	...	...	...	...	...	23
Delusional Insanity	...	...	...	...	...	6
Confusional Insanity	...	...	...	...	...	1
Manic depressive	...	...	...	...	...	2
Affective reaction	...	...	...	...	...	1
Mental derangement	...	...	...	...	...	1
Alcoholic dementia	...	...	...	...	...	3
Epilepsy	...	...	...	...	...	1
Mental defective	...	...	...	...	...	2
Normal	...	...	...	...	...	4
Re-examination	...	...	...	...	...	1

The Nervous Diseases Centre continued to provide extramural care for psychotics and psychoneurotics. The number of cases seen during the year was :—

New cases	...	...	...	...	...	1500
Return attendances	...	...	...	...	...	3168

There were 3096 attendances for neurosis and 1572 for psychosis. Cases comprised 2794 males and 1874 females. Of all cases 420 were children below 14 years old. Approximately 25 per cent were in fear behaviour disorders, infantile anxieties and transient delirious reactions.

Diagnostic range included all familiar types of neurotic and psychotic disorders. Delirious reactions arising on bases of multiple and variable aetiologies come next in frequency to the combined incidence of schizophrenia and affective psychosis.

Treatment by physical methods including electro-convulsion therapy, electro-narcosis and modified insulin was used in selected cases.

There were 101 male and 7 female patients in the Criminal Lunatic Asylum. 25 males and 3 females were admitted during the year. 9 males were discharged.

Health Education. Weekly broadcasts on medical subjects were made from Radio Omdurman. According to replies to a questionnaire they were the second most popular feature of the programme, though there were criticisms that talks were sometimes couched in language beyond the understanding of a lay audience. The press demonstrated a constant interest in health subjects. Press comment, whether critical or laudatory, was of value in awakening public interest in health. Frequent questions in the House revealed the concern of legislators in many aspects of public health.

CHAPTER V.

PORT HEALTH. QUARANTINE.

No seaport or airport was declared infected.

Disinsection of aircraft and quarantine control of air travellers was undertaken at Wadi Halfa, Port Sudan, Khartoum, Juba, Malakal, Geneina and El Fasher airports.

The *Aedic* index was calculated on an inspection of all habitations within the area concerned. Table XXVI shows the *Aedic* index throughout the year at certain airports on international routes.

TABLE XXVI.
Aedes Aegypti index—1953/54.

MONTH	Fasher	Juba	Kassala	Port Sudan	Khartoum	El Obeid	Wadi Halfa	Malakal
July	...	—	0.3	—	—	0.02	—	—
August	...	—	0.3	0.04	—	0.2	—	—
September	...	—	—	—	—	0.04	—	—
October	...	—	—	—	—	0.02	—	—
November	...	—	—	—	—	0.01	—	—
December	...	—	—	—	—	—	—	—
January	...	—	—	—	—	—	—	—
February	...	—	—	—	—	—	—	—
March	...	—	—	—	—	—	—	—
April	...	—	—	—	—	—	—	—
May	...	—	—	—	—	—	—	—
June	...	—	—	—	—	—	—	—

Port Sudan Quarantine. 1344 ships entered Port Sudan harbour. The number of sambuks entering Flamingo Bay was 474. Radio pratique was granted to 624 ships. No case was isolated in the quarantine station.

Suakin Quarantine. The number of pilgrims who have left Suakin for Jeddah in the past 10 years has been :

1944/45	...	...	...	...	...	6,999
1945/46	...	...	...	...	...	6,214
1946/47	...	...	...	...	...	8,404
1947/48	...	...	...	...	...	12,020
1948/49	...	...	...	...	...	11,105
1949/50	...	...	...	...	...	5,091
1950/51	...	...	...	...	...	4,666
1951/52	...	...	...	...	...	6,491
1952/53	...	...	...	...	...	15,051
1953/54	...	...	...	...	...	13,950

531 pilgrims left Port Sudan for the Hedjaz by air in 1953/54.

All outgoing pilgrims were immunised against cholera, smallpox and yellow fever.

The pilgrimage was declared clean. Returning pilgrims were detained in quarantine only for medical formalities to be undertaken.

Wadi Halfa Quarantine. Routine examination for schistosomiasis of persons entering the Sudan from the north was stopped. Delousing with D.D.T. powder was imposed on third class passengers on reports of typhus fever in Egypt. 649 river vessels were inspected.

Geneina Quarantine (Disa). 18,399 persons passed through the post. Delousing with D.D.T. powder was imposed. 5,827 persons were vaccinated against smallpox and 4,013 inoculated against cholera.

Medical Mission to the Hedjaz. The mission consisted of two doctors and 25 other staff. Treatment centres were established at Jeddah, Mecca, Muna and Medina. Medical care was afforded to many nationalities, including pilgrims and local population. 12,528 out-patient cases were treated. 86 persons were given in-patient treatment.

CHAPTER VI.

HOSPITALS, DISPENSARIES, DENTAL UNIT.

TABLE XXVII.

Number of hospitals and beds available.

PROVINCE	No. of hospitals	Beds in hospitals	No. of dispensaries and dressing stations	Beds in dispensaries	Total beds	Beds per 1000 population.
Bahr El Ghazal ...	2	372	35	334	706	0.67
Blue Nile ...	7	1,130	140	63	1,193	0.58
Darfur ...	4	432	56	172	604	0.57
Equatoria ...	8	1,014	69	546	1,560	2.23
Kassala ...	3	696	62	195	891	1.10
Khartoum	7	1,072	33	24	1,096	2.40
Kordofan ...	5	707	68	564	1,271	0.63
Northern ...	6	696	90	20	716	0.88
Upper Nile ...	1	254	41	130	384	0.50
TOTAL ...	43	6,373	594	2,048	8,421	0.86

No new hospital was opened, but a medical officer was stationed in Zalengei and the existing buildings were used as a hospital until the construction of new premises was finished. There were unforeseen delays in constructional work at Bor. Steady progress was made on the new teaching hospital in Khartoum. The isolation hospital at Omdurman was largely re-conditioned and, under the designation Abu Anga Chest Hospital, provided 96 beds for tuberculosis cases. Building of the new hospital at Singa reached an advanced stage.

Medical Services buildings completed during the year included :—

PROVINCE	Locality	Buildings erected.
Bahr El Ghazal ...	Wau	Surgeon's consulting room. X-ray department.
" " "	"	Female paying ward.
Blue Nile ...	Wad Medani	House for ophthalmologist.
" " "	Kosti	Paying wards.
" " "	Ed Dueim	House for medical officer.
" " "	Gezira	Bilharzia Research Laboratory.
Darfur ...	El Fasher	Female ward. Bath room and sluice room. Lecture room.
" " "	"	Out-patient department.
" " "	Nyala	House for medical officer. Paying ward
Equatoria ...	Juba	House for woman doctor. 3 quarters for nursing sisters. House for Asst./P.M.O.H.
" " "	"	House for gynaecologist.
" " "	Kapoeta	House for clerk. 4 houses for dressers.

PROVINCE	Locality	Buildings erected.
Kassala	Kassala	Tuberculosis wards. Additions to hospital. House for surgeon. Out-patient department. Lecture room. House for province medical assistant. House for public health inspector. Additions to public health offices.
"	"	"
"	"	"
"	Port Sudan	Asphalt roads in hospital.
"	" "	Eye out-patient centre.
"	Gedaref	Physiotherapy department. Gynaecology ward.
"	"	House for Asst./P.M.O.H.
"	"	House for public health inspector.
Northern	Merowe	Maternity ward. Hospital garage.
"	"	2 houses.
Upper Nile	Ed Damer	Maternity block.
	Malakal	

The programme of expansion of dispensary services was maintained. Additions included :—

PROVINCE	New dispensaries	New dressing stations	Dispensaries improved
Bahr El Ghazal	3	2	1
Blue Nile	3	2	7
Darfur	3	3	1
Equatoria	2	0	3
Kassala	4	3	5
Khartoum	0	1	0
Kordofan	2	8	2
Northern	3	2	2
Upper Nile	2	0	3
TOTAL	22	21	24

Dental Unit. The professional staff of the unit was reduced to two by resignations. The apprentice dental mechanics under training made satisfactory progress. The Senior Dental Surgeon made a tour of the southern provinces. Consideration was given to a project for training dental nurses, but it appeared impracticable until a larger professional staff was available to enable proper supervision of such auxiliaries.

CHAPTER VII.

MEDICAL MISSIONS.

The work reported by medical missions is shown under :—

		In-patients	Out-patients	Operations
CHURCH MISSIONARY SOCIETY.				
Omdurman (Khartoum Province)	...	1,348	49,223	283
Sallara (Kordofan)	...	147	19,857	—
Katcha (Kordofan)	...	751	3,464	—
Lui (Equatoria)	...	662	17,371	339
Moro dispensaries	...	818	154,326	722
AMERICAN MISSION.				
Nasir (Upper Nile)	...	153	37,558	—
Pibor (Upper Nile)	...	—	4,688	—
SUDAN UNITED MISSION.				
Abri (Kordofan)	...	772	31,627	—
Tabaniya (Kordofan)	...	—	11,112	—
Kauda (Kordofan)	...	194	1,535	—
Heiban (Kordofan)	...	591	24,538	—
Moro (Kordofan)	...	630	8,274	—
SUDAN INTERIOR MISSION.				
Abayath (Upper Nile)	...	—	1,738	—
Banjang (Upper Nile)	...	—	1,481	—
TOTAL	...	6,066	367,292	1,344

CHAPTER VIII.

MEDICAL TRAINING.

(i) *School of Hygiene.* Thirty-one students were attending the public health officers' training course, 10 in the first year, 10 in the second year and 11 in the third year. All third year students entered the examination for the Certificate of the Royal Sanitary Institute in December, 1953. Ten were successful.

6 sanitary overseers passed a proficiency test after a course of training. 3 Libyan students, having fellowships from the World Health Organisation, satisfactorily completed an 11 month course in practical hygiene.

Demonstrations in practical sanitation were given to medical students of the Faculty of Medicine. Lectures were given to pupil medical assistants and pupil health visitors. 8 students under training in Khartoum Technical Institute for future work in connection with the main drainage installation were given a part of their instruction in the School.

(ii) *Medical Assistants Training School, Omdurman.* 25 candidates passed a proficiency test at the end of the training course. There were 50 pupils in the school, 25 in the first year and 25 in the second year.

Laboratory technicians training. A departure was made from the principle of recruiting pupils of elementary education standard from the nursing staff for training as laboratory assistants. 4 students of secondary education level were embarked on a course of instruction designed to train them as fully qualified laboratory technicians. The policy of giving a more advanced course to serving laboratory assistants was continued and 20 have now passed the proficiency test following this course, thus qualifying for a higher pay scale. It was decided that the standard of laboratory assistants from the southern provinces was generally below that of those from the north. Consequently it has been arranged to post southern laboratory assistants to the Stack Laboratories for a refresher course of three months. 6 laboratory assistants undertook this course.

School of dispensers. 5 students finished the training course and passed the proficiency test. 4 subsequently entered government service as hospital dispensers.

Radiographers. 8 students were under training.

Juba Training Centre.

Medical assistants. 3 final year students passed the proficiency test. The number of pupil medical assistants under training was :—

1st year ...	...	...	...	...	...	11
2nd year ...	...	...	...	...	...	7
3rd year ...	...	...	...	...	...	8

Laboratory assistants. 1 candidate was entered for training.

Sanitary overseers. 7 candidates began a training course.

Nurses Training Schools. Ten schools were recognized for the "in-service" training of nurses covering the full period of three years. A further nine schools were recognised as capable of undertaking the shortened training course of one year. 126 nurses were certificated after successfully completing a three-year training course. 63 nurses received certificates on completion of the shortened training course of one year.

(1) STACK MEDICAL RESEARCH LABORATORIES.

BY DR. M. A. HASEEB.

Ad hoc investigations were undertaken on Yellow Fever, Schistosomiasis, Leprosy, Heterophile agglutination, and Neoplasms. Summaries of these and other research activities will be found under the appropriate headings.

Among visitors to the Laboratories were Dr. R. Lewthwaite, Chief Medical Research Officer, Colonial Service. He came on his way back from a conference on Yellow Fever in Singapore. His visit was both instructive and stimulating and various research problems were discussed with him with advantage. Dr. Richard M. Taylor, Director of the Department of Virology, United States, Naval Medical Research Unit No. 3, Cairo, and his assistant Dr. Telford Work paid a visit to the Sudan in March. Their object was to investigate the epidemiology of Yellow Fever in the Sudan. Together with the Assistant Director (Research) they toured Kordofan and Bahr El Ghazal Provinces and collected human and animal sera to be tested for Yellow Fever as well as other viruses.

EDUCATIONAL AND ROUTINE ACTIVITIES :

Technicians' Class : Four secondary school students were recruited for a three-year course on advanced Bacteriology, Haematology, Biochemistry and Pathology. This was to fulfil a long felt desire to employ Sudanese technicians with a good basic education in the Natural Sciences. A useful technician should have a good working knowledge of physics, chemistry and biology. The Laboratory Superintendent was exempted from routine work to devote himself completely to the teaching of this class. Already a great deal of ground has been covered and it is hoped that these technicians will meet a genuine need when their training has been completed.

It has been possible to give training on laboratory technique and care of laboratory animals to two of the staff of the Veterinary and Agricultural Schools of Khartoum University.

Teaching of academic and practical bacteriology to the medical students in the Faculty of Medicine, Khartoum University College and also the teaching of forensic medicine to the candidates of the Sudan Police College have made heavy demands on the time of the laboratory staff.

A large number of sections for histopathological examination were cut from various big game shot in the animal eviction camp at the tse-tse reclamation areas of Bahr El Ghazal Province. The animals included giraffe, hippopotamus, cob etc. This was done in response to a request from the Veterinary Research Laboratories, Khartoum, who were looking for pleuropneumonia in animals.

A summary of the work and examinations carried out during the period under review is appended to this report. The total number of examinations was 34,452 as compared with 31,147 in the previous year. This increase is principally in the number of antibiotic sensitivity tests carried out in the item of general bacteriological tests, an increase from 833 tests last year to 3971 this year. There was also an increase in the biochemical tests from 504 to 640 tests. The histopathological examinations, including sections of brains for rabies, increased from 1144 in the last year to 1423 this year. Water tests increased from 98 to 146 this year.

Many specimens of snakes, spiders and skinks were sent to the laboratories from the Provinces for identification.

The issue of lymph vaccine increased from 1,157,150 last year to 1,571,140 doses this year.

POST MORTEM EXAMINATIONS.

34 post mortem examinations were performed in Khartoum Civil Hospital in the year under review. Of these 23 were medico-legal.

PATHOLOGICAL SPECIMENS.

The total was 1106 excluding brains for rabies ; the total for the previous year was 717.

NEOPLASMS.

179 malignant neoplasms were received of which the following table is a summary :—

MALIGNANT TUMOURS.

SITE	Carcinoma	Sarcoma	Melanoma	Mixed	Total
Scalp	8	—	—	—	8
Jaw	3	—	—	—	3
Face	3	—	—	—	3
Tongue	5	—	—	—	5
Mouth	7	1	—	—	8
Eye	4	1	—	—	5
Neck	5	1	1	—	7
Parotid	1	—	—	12	13
Chest	1	1	—	—	2
Shoulder	1	—	—	—	1
Back	1	—	—	—	1
Leg	5	1	—	—	6
Foot	0	2	7	—	9
Groin	—	1	—	—	1
Anus	3	—	—	—	3
Rectum	10	—	—	—	10
Abdomen	6	1	—	—	7
Liver	2	—	—	—	2
Bladder	3	—	—	—	3
Penis	2	—	—	—	2
Ovary	5	—	—	—	5
Testicle	2	—	—	1	3
Uterus	5	1	—	—	6
Vulva	2	—	—	—	2
Cervix	9	—	—	—	9
Breast	25	—	1	—	26
Lymph gland	6	5	2	—	13
Skin	3	—	1	—	4
Bone	1	1	—	—	2
Unspecified	7	1	2	—	10
TOTAL	135	17	14	13	179

Dr. Bates, the pathologist, comments on these neoplasms as follows : The case of most interest was a solitary tuberculoma in the left cerebellar pontine angle. The primary focus of infection was a fibro-caseous lesion in the apex of the left lung.

An interesting section seen during the year was a sweat gland tumour arising in the skin of the forehead in a youth of 20. The tumour was encapsulated, about 3 cms. in diameter and had been present for about 8 years when removed. Half the tumour was sent to Prof. R. A. Willis who kindly reported the sections as follows :—

Sweat-glandular tumour of the benign pleomorphic type (somewhat resembling a salivary tumour) composed of irregular tubules and epithelial trabeculae, with foci of squamous differentiation set in an abundant fibrous stroma with much hyaline change. Prominent melanin pigmentation of the epithelium is present in places. Mucin formation is not a feature, but a few small areas of epithelial pseudocartilage are present. There are also some foci of calcification, evidently in degenerated epithelial clumps or other secretion and accompanied here and there by early bone formation.

RABIES.

317 brains were received of which 20 were badly decomposed and useless for examination. 83 of the remaining 297 were positive for Negri bodies. This contrasts with 148 positives out of 427 brains examined last year.

The species of distribution of positives and negatives in present year's series is shown in the following table.

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Rabies Examination.

ANIMAL		Positive	Negative	Decomposed	Total
Dog	...	59	178	16	253
Donkey	...	8	8	1	17
Cat	...	2	14	1	17
Goat	...	4	4	0	8
Bovine	...	6	2	2	10
Horse	...	1	3	—	4
Dik-Dik	...	1	1	—	2
Mule	...	—	1	—	1
Camel	...	1	—	—	1
Ram	...	—	1	—	1
Monkey	...	1	1	—	2
Cerval-cat	...	—	1	—	1
TOTAL	...	83	214	20	317

The smear method for diagnosis of rabies which was started last year was continued on all fresh brains received for sectioning. As in last year's experience it was found that all brains which gave a positive smear were also positive in section, but the reverse is not necessarily true.

Rabies Vaccine.

293,625 mls. were issued this year compared to 316,725 mls. issued last year.

LYMPH VACCINE.

Research : Advantage was taken of the incidence of one case of Smallpox in Khartoum, imported from Kutum, and vesicle fluid was collected for experimental work on monkeys. The aim of the experiment is to infect monkeys by the respiratory route and look for primary lesions in the lungs visualised by Downie *et-al* (1948). The experiment is still in progress.

Carbolished lymph-vaccine : It is well known that phenol can reduce the bacterial count of lymph vaccine so much so that within a fortnight from preparation it can be issued for use. It was however felt that in an institution where lymph is prepared in such large quantities, that phenol should not be finally adopted for routine work before several year's study of its effect on the potency of the vaccine. Work on small experimental scale for several years now has convinced us that phenol has no marked deleterious effect on potency and Maclean's method of phenolising lymph vaccine has now been adopted for the routine preparation of the vaccine. The result is that lymph vaccine with a high potency and a colony count as low as 3 to 4 thousand organisms per ml. can be issued shortly after preparation.

Routine : 132 sheep were used for the production of 7570 grams of pulp with an average yield of 573 grams per sheep.

SCHISTOSOMIASIS.

Mr. S. Markowski, the fresh-water hydro-biologist, carried out a survey on the molluscan vectors of Schistosomiasis in the Gezira Irrigated Area from December 23rd 1952 to April 8th 1953. (Markowski (1953) Annals of Trop. Med. and Paras., 47,4). He used no elaborate methods for the collection of snails ; a simple hand-net was satisfactory in all areas where searches were made. He carried out investigations in the following sites : Sennar reservoir, the main canal of the Gezira Irrigated system, the Kassab el Doleib and Bussata irrigated systems and the Jebel Moya haffir. His findings were as follows : *Bulinus truncatus* was found in the Sennar reservoir and the main canal, while *Planorbis boissyi* was absent from the southern sector of the main canal but predominated elsewhere. Kassab el Doleib and Bussata irrigated systems and Jebel Moya haffir were free from snails.

In interpreting these interesting findings he suggested that the snails were carried into the Sennar reservoir by the current of the Blue Nile during the flood period and that they then passed through the sluices to the main canal and thence into the rest of the Gezira Canals.

Further work is certainly required to confirm or refute this theory.

Q. FEVER.

In continuation of last year's survey 268 human sera were collected from various places in the Sudan to be tested for the presence of complement fixing anti-bodies to Q. fever. The result is tabulated as below :—

Complement Fixation Results on Q. Fever.

PLACE	No. Sera	No. Neg.	1/8	1/6	1/32	1/64	AC	Total Pos.	% Pos.
Rashad ...	23	13	1	1	0	0	7	2	15
Abu Zabad ...	45	35	2	3	1	0	4	6	17
Nahud ...	26	24	1	1	0	0	0	2	8
Mayen Mission ...	20	19	0	0	0	0	1	0	0
Muglad ...	35	34	0	1	0	0	0	1	3
Kadugli ...	29	27	0	2	0	0	0	2	7
Um Dorein ...	24	21	1	1	0	0	1	2	10
Talodi ...	25	23	0	1	0	0	1	1	4
Salara ...	26	24	0	1	0	0	1	1	4
Tukma ...	16	13	1	1	0	0	1	2	15
TOTAL ...	268	233	6	12	1	0	16	19	8

N.B. Anticomplementary Sera are excluded from the percentage.

These results require no special comment. They are not dissimilar to the results obtained on sera previously collected in the Sudan. Dr. Richard M. Taylor is of the opinion that infection with Q. fever or some antigenically allied agent is widespread in the Sudan, but is of low incidence. It is doubtful if it is of any great importance as a health hazard. It should be remembered however that these reactions which occur only in low dilutions of the sera may be due to some allied infection which is giving rise to complement fixing anti-bodies to Q. fever.

WEST NILE VIRUS.

In continuation of last year's survey 268 human sera were collected from various parts of the Sudan to be tested for the presence of complement fixing anti-bodies to West Nile Virus were also carried out for comparison purposes. The results of these tests are tabulated below :—

Complement Fixation Results on West Nile.

PLACE	No. Sera	No. Neg.	1/4	1/8	1/16	1/32	AC	Total Pos.	% Pos.
Kasha ...	22	3	2	3	1	*1	12	7	70
Abu Zabad ...	45	22	7	7	1	1	7	16	42
Nahud ...	26	15	3	6	0	0	2	9	38
Mayen Mission ...	20	7	4	5	0	0	4	9	56
Muglad ...	35	28	4	2	1	0	0	7	20
Kadugli ...	29	22	4	1	0	0	2	5	19
Um Dorein ...	24	8	3	9	1	1	2	14	64
Talodi ...	25	14	1	6	0	0	4	7	33
Salam ...	26	23	2	0	0	0	1	2	8
Tukma ...	16	16	0	0	0	0	0	0	0
TOTAL ...	268	158	30	39	4	3	34	76	32

NOTE :— *1/64. AC (anticomplementary reactions) are excluded in calculating the percentage of positives.

*Comparison of Complement Fixation and Neutralization tests
with W N virus on 41 Sera.*

NEUTRALIZATION	Neg. 1/4	C.f. tests				Totals	
		Positive					
		1/4	1/8	1/16			
Negative	23	4	1	0	28		
Positive	1	3	7	2	13		
TOTALS	24	7	8	2	41		

From these results the evidence is fairly convincing that infection with the virus is frequent and occurs over most of the Southern Sudan. Tukma, a village which is 16 miles west to Dilling, seems to be free and Salara which is a neighbouring village has the lowest percentage of positives.

There was not as close a correlation between the complement fixation and neutralisation tests with West Nile virus as usually obtained. Only 12 of the 13 sera tested neutralised the virus gave a positive complement fixation reaction but there was one serum which neutralised the virus and failed to fix complement. There were also five sera that fixed complement in low dilution which failed to neutralise the virus. It is just possible that some other viral infection allied to West Nile may be involved in these discrepancies.

Presumably infection with West Nile virus is prevalent and widespread in the Sudan, but it is doubtful if it is a serious health hazard. In Egypt where it is common Dr. R. M. Taylor was not able to identify it with encephalitis and he is of the opinion that the clinical manifestations are limited to a low grade fever associated with muscular pains, perhaps some stiffness of the neck occasionally a mild rash which would probably not be observed in persons of dark skin followed by complete recovery within a few days to a week.

YELLOW FEVER.

The yellow fever position in the Sudan is of great interest. Since the discovery of the mouse protection test which is a simple means of detecting the presence of immune bodies to yellow fever the International Health Division of the Rockefeller Foundation initiated a survey in Africa in 1933. The results of this survey for the Sudan were published by Hewer in 1934 and by Sawyer and Whitman in 1936. The results of another survey were published by Kirk in 1936, and in 1937 and 1938 Findley carried out further studies. In 1940 the Sudan witnessed the biggest outbreak of yellow fever in Africa. In 1953 the American Naval Medical Research Unit No. 3 collected 406 human sera from various localities in the Sudan and sent them to the Virus Research Institute at Entebbe for testing. The results are tabulated below :—

Results of Yellow Fever Protection Tests.

LOCALITY	Under 15 Years.			Over 15 Years.			All ages combined		
	Valid Tests	Pos.	% Pos.	Valid Tests	Pos.	% Pos.	Valid Tests	Pos.	% Pos.
Ganzi	5	0	—	3	1	—	8	1	13
Gilo	4	0	—	34	14	41	38	14	37
Gogrial Area	6	0	—	11	6	54	17	6	35
Juba	19	3	16	20	5	25	39	8	21
Kaguada	13	1	8	18	4	22	31	5	16
Katire	15	1	7	25	6	24	40	7	17
Keyala	24	2	8	20	4	20	44	6	14
Khartoum	26	1	4	56	3	7	82	4	6
Malakal	18	8	44	23	8	35	41	16	39
Torit	21	4	19	7	—	—	28	4	14
Yei	16	1	6	22	8	36	38	9	24
All Areas combined ...	167	21	13	239	59	21	406	80	20

The estimated ages by locality are as follows :—

Locality	Ages of Immune Children
Juba ... ... ...	... 8, 12, 12
Kaguada ... ... ...	... 10
Katire ... ... ...	... 6
Keyala ... ... ...	... 9, 14
Khartoum (Buri Dispensary) ...	... 12
Malakal ... ... ...	... 5, 6, 8, 8, 8, 10, 12, 12
Torit ... ... ...	... 7, 10, 11, 12
Yei ... ... ...	... 12

In interpreting these interesting results one should bear in mind, apart from natural infection with yellow fever, the possibility of yellow fever inoculation. It is true that in localities like Katire and such remote villages artificial yellow fever inoculation is unlikely to be the cause of the presence of immune bodies, but in the big towns like Khartoum the population is pretty well vaccinated. It should also be borne in mind that there is a constant influx of people to Khartoum from the endemic area in the Nuba Mountains for work. It is a great pity that accurate histories of the positive children in this series from Khartoum were not recorded at the time of collecting the samples.

Of marked interest was a sample of animal sera collected in 1953. Two hedgehogs were negative. One adult and two old baboons were both positive. Of the juvenile baboons two were positive (though here it is not possible to exclude passive immunity derived from the mother).

In reporting the above interesting results of human and animal sera Dr. L. E. Hewitt of the Virus Research Institute, Entebbe, suggests that sera be procured from bush-babies as it is felt that a sample of these animals might throw much

further light on the situation (Hewitt (1953) Annual Report of Virus Research Institute, Entebbe, 4). In March 1954 Dr. Richard M. Taylor and Dr. Telford Work of NAMRU together with the present writer made an extensive tour into Kordofan and Bahr El Ghazal Provinces. They spent six weeks in studying the epidemiology of yellow fever in those two provinces. 268 human sera were collected and over 150 sera were collected from primates, of which 50 were bush-babies. These sera are still being tested for yellow fever and the results are not yet to hand. Bush-babies (Galagos).

Great interest in these animals in connection with yellow fever was aroused by the results of yellow fever protective tests in the sera of Primates from Kenya published by Haddow (1952) in the Annals of Trop. Med. and Parasitology. He brought evidence to suggest that in Kenya and the driest parts of East Africa bush-babies and not monkeys might be the main mammalian hosts of yellow fever virus. The importance of including a series of bush-babies in surveys in such areas was stressed.

In the Sudan the common species is *Galago Senegalensis senegalensis*.

In the various areas visited in Kordofan and Bahr El Ghazal the population is about 25 Galagos per square mile. This extends from a point about 30 miles west to El Obeid throughout Kordofan Province up to Wau in Bahr El Ghazal. The animals live in semi-arid open savannah forest without a canopy ; they inhabit mainly the acacia tree ; spend the day in tree holes and come out at night to feed on gum resins. They have large red glowing eyes which are most marked at night when the animals keep jumping from branch to branch. Bush-babies are quite harmless animals and can be caught by trained people. The Nubas eat them and therefore in some localities in the Nuba Mountains they cannot be found.

The susceptibility of *G. senegalensis* to yellow fever was investigated by Bugher (1951) who found it to be as suitable a host animal as most African monkeys ; there being abundant virus multiplication and circulation in the blood, followed by immunity with little or no illness.

The sera of ten *G. senegalensis* from the Nuba Mountains were all found negative when tested for yellow fever immunity (Kirk and Haseeb 1953). Over 50 sera were collected this year from Galagos from Kordofan and Bahr El Ghazal Provinces but the results of the tests are not yet to hand.

AN UNUSUAL ENTERIC INFECTION.

Several out-breaks of enteric fever occurred in various parts of the country. Comparatively big outbreaks occurred in Atbara and Dongola Towns. The mode of infection and progress of the disease was orthodox in all these cases except for one case which was unusual. An arab male from Um Ruwaba, aged 42 years, reported to Khartoum Civil Hospital with an abscess on the upper third of the right thigh. He ran a hectic temperature for about a month. The abscess was incised and curetted. From the pus a pure culture of *Salm. para. B.* was isolated, which organism was agglutinated by the patient's serum in significant titre. The organism could not be recovered from the blood, faeces or urine by culture.

This is the second occasion for *Salm. para. B.* which is rare in the Sudan, to give rise to a localised abscess without evidence of generalised infection. The first case was recorded in my report of 1945.

TUBERCULOSIS.

Owing to the great interest taken by the World Health Organisation in this subject in the Sudan and their carrying out both tuberculin testing and B.C.G. vaccination in the Southern Provinces, the present writer made a review of all previous tuberculin surveys including the recent survey performed by him in Khartoum Province. The review is in the press (Haseeb (1954) J. Trop. Med. and Hyg.).

BLOOD.

The survey for the distribution of sickle cells carried out by Dr. Henry Foy and Dr. Athene Kondi, of the Wellcome Trust Research Laboratories, in the Southern Sudan was completed and the results were published (Foy, H. et al (1954) B.M.J., 1,294). The findings in 26 tribes are tabulated below :—

Sickle-cell Trait.

RACE OR LANGUAGE GROUP	Tribe	Subtribe	Location	No. Examined	Positive	
					No.	%
Nilotic	Dinka	Bor	Malek	87	0	0
"	"	"	Cattle Post	77	2	3
"	"	Duk	"	22	0	0
"	"	Melut	Melut	20	0	0
"	"	Toich	Sobat	38	0	0
"	Nuer	Adok	Adok }	100	1	1
"	"	Ler	Ler }			
"	Shilluk	Tonga	Tonga	100	0	0
"	"	Malakal	Malakal	56	0	0
" ?	Mandari	Terakeka	Terakeka	105	18	17
" ?	"	Tali Post	Tali Post	98	7	7
"	Acholi	Torit	Torit	54	6	11
" ?	Lango	"	"	30	1	3
"	Anuak	Lafon	Lafon	96	8	8
" ?	Madi	Opari	Opari	71	13	18
Nilo-Hamitic speaking group	Bari	Bari (true)	Rejaf	100	7	7
	Fajelu	Fajelu	Lainya	100	9	9
	Kuku	Kuku	Yei	39	3	8
	Kakwa	Kakwa	"	76	6	8
Bongo-Mittu-speaking group	Baka	Baka	"	105	9	8
	Moro	Moro	Juba	71	2	3
	Mundu	Mundu	Yei	80	13	16
Lotuku-speaking group	Latuka	Latuka	Lambalua	72	0	0
	Dongotona	Dongotona	Isoke	70	0	0
	Lokoiya	Lokoiya	Liria	98	5	5
Didinga-speaking group	Longarim	Longarim	Wathit Forest	73	1	2
	Logia	Logia	"	38	0	0
Western Bantu ?	Azande		Juba	28	3	11

Commenting on the above results, the authors stated that there were great variations in the percentage of sickling and A.B.O. groups, not only among different tribes but also in subgroups within the same tribe although they speak the same language, have the same cultural and social characteristics and now intermarry freely. The Mandaris of Terakeka have a sickle cell rate of 17 per cent whilst the Mandaris of Tali Post have a rate of only 7 per cent although such both groups speak the same language and are surrounded by Dinkas whose rate is less than 1 per cent.

It would have been of considerable interest if in this survey the percentage of sickling was correlated with subtertian malaria infection. Many workers (Beet, (1946); Brain, (1952); and Allison, (1954) have brought strong evidence to the effect that the abnormal erythrocytes of individuals with the sickle-cell trait are less easily parasitized by *P. falciparum* than are normal erythrocytes.

This fact may explain why the sickle-cell gene remains common in malaria hyperendemic areas in spite of the elimination of genes in patients dying of sickle-cell anaemia.

HETEROPHILE ANTIBODY (PAUL-BUNNELL TEST).

The sheep-cell agglutination test for glandular fever described by Paul and Bunnell (1952) is widely used and provided certain considerations are taken into account, an increased sheep-cell agglutination titre is strong evidence of glandular fever. Barrett (1941) devised a new technique which was an advance on the original Paul-Bunnell Test because it differentiated between anti-bodies due to glandular fever, the natural ones and those due to serum sickness. A fundamental essential for this technique is to determine beforehand the level of natural agglutinins in the community to be tested. Therefore one thousand sera from people known not to be suffering from glandular fever were collected from all over the country and tested by Dacie's modification of Barrett's technique (1950). The results of the tests are tabulated below :—

*Result of Paul-Bunnel test on 1000 Non-Glandular Fever
Persons in The Sudan.*

SOURCE	No. of Sera	Unabsorbed serum				Guinea Pig-Kidney absorbed serum				Ox-cell absorbed serum				No. of Sera completely negative.			
		1:10	1:20	1:40	1:80	1:160	1:10	1:20	1:40	1:80	1:160	7	2	0			
Khartoum Province	420	95	93	39	16	2	0	1	0	1	41	25	7	2	142		
Blue Nile ,	164	36	23	18	0	0	2	1	0	0	5	4	0	0	75		
Northern ,	127	36	12	17	7	0	1	0	0	0	0	9	7	3	61		
Kordofan ,	89	16	11	5	6	1	0	0	0	0	0	7	2	1	47		
Kassala ,	36	11	7	2	2	0	0	0	0	0	3	3	0	0	14		
Darfur ,	94	22	15	8	4	0	0	0	0	0	3	3	0	0	33		
Upper Nile ,	50	10	6	4	0	0	0	0	0	0	7	2	0	0	24		
Equatoria ,	20	7	2	1	0	0	0	0	0	0	1	3	0	0	10		
TOTAL	1,000	233	169	94	35	3	5	1	1	0	1	76	49	12	4	0	406

PRECIPITIN TESTS.

In the routine preparation of type-specific antisera for the medico-legal blood precipitin tests, the animals used are rabbits, some of which are fresh but some are rabbits which had been used for titrating the potency of vaccine lymph. It was noticed on more than one occasion that rabbits previously used for potency titration failed to produce antibodies of high titre. *A priori* this seemed to be an example of the interference phenomenon. An experiment therefore was undertaken to check the veracity of these observations.

Twelve rabbits were inoculated with human serum antigen by the method of Proon (1943). Six of the rabbits had been recently used for the titration of vaccine lymph potency. Six had no treatment and were used as normal controls. There was no significant difference in the rate of antibody production. The average of the maximum titres attained by the control rabbits was 1/2930 and that of vaccinated rabbits was 1/1760. The final titres are tabulated below :

Fresh rabbits		Vaccinated rabbits	
No.	Titre	No.	Titre
1	1/3,200	7	1/3,200
2	1/3,200	8	1/1,600
3	1/1,600	9	1/1,600
4	1/6,400	10	Died
5	1/1,600	11	1/800
6	1/1,600	12	1/1,600

LEPROSY.

The use of para-actamidobenzaldehyde thiosemicarbazone in the treatment of leprosy in Nigeria has been favourably reported on by Lowe (1952). A small quantity of Neustab Brand of Thiacetazone was made available for trial through the courtesy of Boots and Co.

A group of twelve adult cases of leprosy was started on treatment with this drug. Patients before treatment were examined and both nasal smears and skin scrapings showed *Myco. leprae* in fair numbers. The full details of the trial will be published elsewhere but the following points are worthy of record here :

1. Dosage : The dose given was 25 mg. daily for the first week and then increased gradually to 150 mg. daily divided in three equal parts and given after meals.
2. Nasal smears became negative for lepra bacilli after three months treatment. Skin scrapings, however, were still positive after years therapy.
3. Within one month of commencing treatment a marked improvement in the clinical picture including the disappearance of nodules and thickening of the skin was observed.
4. No cases of agranulocytosis or other toxic effects were encountered. A generalised increase in the depth of the pigmentation of the skin was noticed in all patients.

Summary of Routine Examinations.

From 1st July 1953 to 30th June 1954.

Kahn tests	...	...	...	...	...	...	...	...	16,870
Widals	...	...	...	...	...	...	...	...	2,196
Weil-Felix	...	...	...	...	...	...	...	...	1
Heterophile agglutination (Paul-Bunnell)									11
Blood cultures	...	...	...	...	...	...	...	...	1,325
Blood Films	...	...	...	...	...	...	...	...	1,129
Blood counts	...	...	...	...	...	...	...	...	154
C.S. Fluids	...	...	...	...	...	...	...	...	201
Medico-legal (Blood and Seminal stains)	...	...	...	...	...	...	...	...	49
Biochemical tests	...	...	...	...	...	...	...	...	640
Autogenous vaccines	...	...	...	...	...	...	...	...	2
Pathological Histology (including Rabies)									1,423
Faeces	...	...	...	...	...	...	...	...	2,477
Urine	...	...	...	...	...	...	...	...	1,672
Throat and Nasal Swabs		Positive							75
	„ „ „ „	Negative							1,999
Sputum T.B.	Positive	...	...	...	...	...	...	...	11
	„ „ Negative	...	...	...	...	...	...	...	100
General Bacteriology	...	...	...	...	...	...	...	...	3,971
Water tests	...	...	...	...	...	...	...	...	146
Total Examinations	...	...	...	...	...	...	...	...	34,452

Summary of Faeces Examinations.

<i>Shigella flexneri.</i> V - Z types	...	...	...	...	...	...	...	...	93
<i>Shigella shigae</i>	...	...	...	...	...	...	...	...	30
<i>Shigella schmitz</i>	...	...	...	...	...	...	...	...	3
<i>S. typhii</i>	...	...	...	...	...	...	...	...	38
<i>S. paratyphii A</i>	...	...	...	...	...	...	...	...	1
<i>Entamoeba histolytica</i>	...	...	...	...	...	...	...	...	4
Ova present	...	...	...	...	...	...	...	...	8
Negative	...	...	...	...	...	...	...	...	2,300

Summary of Urine Examinations.

<i>S. typhii</i>	...	...	...	...	...	...	...	...	9
<i>S. paratyphii A.</i>	...	...	...	...	...	...	...	...	1
Ova present	...	...	...	...	...	...	...	...	4
Negative	...	...	...	...	...	...	...	...	1,658

Summary of Kahn Tests.

Positive	...	...	...	...	...	...	...	...	3,469
Negative	...	...	...	...	...	...	...	...	13,401

Summary of Blood Films.

Benign tertian malaria	...	...	...	...	...	...	...	...	5
Subtertian malaria	...	...	...	...	...	...	...	...	163
Negative	...	...	...	...	...	...	...	...	961

Summary of Widal Reactions.

<i>S. typhi</i>	...	...	...	...	...	...	...	332
<i>S. paratyphi A.</i>	...	...	...	...	...	...	...	1
<i>S. paratyphi B.</i>	...	...	...	...	...	...	...	2
<i>Br. melitensis</i>	...	...	...	...	...	...	...	41
Negative	...	...	...	...	...	...	...	1,820

Summary of Blood Cultures.

<i>S. typhi</i> isolated	...	...	...	...	...	...	...	119
<i>S. paratyphi A</i> isolated	...	...	...	...	...	...	...	7
<i>Streptococcus pyogenes</i> isolated	...	...	...	...	...	...	...	8
Other organisms isolated	...	...	...	...	...	...	...	14
Negative	...	...	...	...	...	...	...	1,177

Summary of Heterophile Agglutination Tests.

Positive	1
Negative	10

Summary of Weil-Felix Reactions.

Negative	1
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Summary of Vaccines Issued.

T.A.B. Vaccine	33,700 ml.
Anti Rabic Vaccine	293,625 ml.
Cholera Vaccine	...	...	...	...	...	...	...	36,200 ml.
Vaccine Lymph	...	...	...	...	...	...	...	1,591,140 Doses

PUBLICATIONS.

HASEEB, M. A. and KIRK R. (1953). Animals and Yellow Fever Infection in the Anglo-Egyptian Sudan. *Ann. Trop. Med. and Parasit.* 47.3.225.

MARKOWSKI, S. (1953). The Distribution of Molluscean Vectors of Schistosomiasis in the Sennar Area of the Sudan and their Invasion of the Gezira Irrigated System. *Ann. Trop. Med. and Parasit.* 47.4.375.

HASEEB, M. A. (in press). Tuberculin Surveys in the Sudan. *J. Trop. Med. and Hyg.*

HASEEB, M. A. and HOLDER, H. J. (in press). Level of natural heterophil sheep-cell agglutinins in the Sudan. *J. Sudan Med. Assoc.*

HASEEB, M. A., KIRK, R. and MoKINNON, R. M. (in press). Observations on Rabies in the Sudan. *J. Sudan Med. Assoc.*

(2) WELCOME CHEMICAL LABORATORIES.

BY MR. D. N. GRINDLEY.

The number of samples examined was fifteen hundred and thirty one as compared with fourteen hundred and seventy three for the previous twelve months. The number of samples of gum arabic examined for the Silviculturist dropped to one hundred and four, about a third the number received last year, but these only call for a very simple empirical test. The main increases were in the number of water samples submitted, principally by the Geological Survey and Drilling Engineer, Ministry of Works, which approached one hundred per-cent more than those received in the previous period, and also in medico-legal and miscellaneous drugs, which is nearly three times greater than for the previous twelve months. The samples examined for the Police increased more than three-fold, and there is every indication that even further demands will be made from this source. The consultative work has also shown an increase, as also has the number of samples submitted by private firms, which was approximately fifty per cent over those received in the previous twelve months. Much time has been spent on the introduction of new methods of analysis and in training the staff in the necessary new techniques.

The general distribution of samples in the various categories has otherwise been broadly similar to that of recent years, a high proportion of the work being of a medical or semi-medical nature.

The research work has consisted of a continuation of the investigation into the probable cause of stringiness in gum arabic. An extension of the work on the incidence of chironomids and the causes of the fluctuations that occur in the prevalence of these insects. Completion of the work referred to last year on the examination of iron-stones containing minor amounts of rarer metals of economic importance. Examination of Sudan vegetable oils not previously described has been continued, and an investigation into the effect of plant hormones on the composition of cottonseed has been started. Research has also been carried out with a view to improving the quality of bricks producable from local materials, and considerable work has also been done on the detection and identification of plant poisons of the rarer type in toxicological specimens. Our attention was also directed to finding a use for the surplus guava crop which the country produces each year.

During the period under review, eight original papers and the Report of the Government Analyst for 1.7.52—30.6.53 were published or prepared for publication.

The routine samples examined were classified as follows, the corresponding figures for the previous twelve months being given :—

								1953/54	1952/53
Waters	...	...	...	...	...	...	...	291	161
Foodstuffs	...	...	...	...	...	...	...	202	215
Medico-legal and miscellaneous drugs	...	...	...	...	...	...	...	387	146
Mineralogical	...	...	...	...	...	...	...	63	117
Miscellaneous	...	...	...	...	...	...	...	588	834

ROUTINE WORK.

Waters.

The majority of the samples submitted were received from the Geological Survey and Drilling Engineer, Ministry of Works; mainly from new bores and wells in connexion with the drive to improve rural water supplies throughout the country. The practice of examining all waters for fluorine content has been continued as a matter of routine, following the discovery of dental fluorosis in certain areas of the Sudan. Regular determinations of dissolved oxygen content of the Blue Nile water at Khartoum has been carried out at fortnightly intervals during the last twelve months to discover if this factor has any bearing on the prevalence of chironomids. Of the two hundred and ninety one samples submitted, six were classified as boiler waters examined for the Sudan Railways, and the remainder as potable waters.

Foodstuffs.

Under this heading were included milk samples suspected of adulteration, alcoholic beverages, grains, flours, butter fats and a variety of vegetable oils examined for suitability for human consumption. An assortment of miscellaneous food-stuffs, including various samples of fruit squashes, sugars, tinned goods, salted fish and others have also been submitted for analysis.

Medico-legal and miscellaneous drugs.

Under this heading were included pathological specimens (63), toxicological (71) and miscellaneous drugs (253). Of the first, the majority were ante- or post-mortem specimens connected with seventeen separate cases of suspected poisoning. Deaths of animals due to arsenical poisoning are still fairly common, the source of arsenic probably being the poisoned bran which is used in locust control. In addition to the above, six bloods were examined for calcium, iron and protein content and three stools for split and unsplit fat, various urines and bones,—mainly in connection with the investigation on the occurrence of dental fluorosis, also samples of calculi.

Among the toxicological samples submitted, a number of specimens of plant materials have been shown to be, or contain, Hashish, and certain others were identified as opium, though others suspected of being opium were shown to consist of dried excreta. Five samples of lubia were examined for hydrocyanic acid content, to comply with the Indian regulation limiting this to 20 p.p.m. A gas cylinder supplied to one of the hospitals was shown to have been filled with nitrous oxide instead of oxygen. The Research Division, Ministry of Agriculture, continued to submit samples of Abavit B for control purposes.

The miscellaneous drugs and other medico-legal samples included a wide range of specimens, many of which were tested for conformity with B.P. Standards. The work initiated last year on the discolouration of quinine ampoules when stored under locally prevailing conditions was continued, a slight but progressive deterioration being observed. Five documents submitted by the Police were shown to have had parts of the original writing altered or erased. In each of these cases, the Government Analyst was required in court to give evidence. Many unknown substances were submitted for identification, amongst which were various tablets submitted by the Police suspected of having been stolen.

Mineralogical.

Included in this category were fifteen samples of coal ; two samples of mineral oil ; and various bronzes and other alloys. In addition regular samples of salt have been received from the Sudan Salt Co., and a number of assorted minerals have been analysed for the Geological Survey,—mainly iron-stones containing minor amounts of manganese, vanadium and titanium. Under this heading were also included various salt deposits, efflorescences and incrustations which have from time to time been received ; samples of lime, limestones and other building materials.

Miscellaneous.

Seventy two samples of oil-cakes, principally cottonseed, sesame and groundnut were received, mainly from private firms, and in addition an increasing number of oil-bearing seeds,—cottonseeds 179, groundnuts 10, sesame 3, castorseed 15, safflower seeds 7, together with odd samples of melonseeds, sheanuts and maize. Eighteen samples of cottonseed husks were also examined. Ninety samples of methylated spirits have been examined for the Sudan Customs, and thirty eight samples of various kinds, but mainly packing and wrapping materials, have been analysed to ascertain the cause of damage, principally in connection with insurance claims. Three samples of soap of local manufacture were received, the quality of which showed considerable improvement over former years, manufacturers now exercising more scientific control over their processes and also using more suitable raw materials.

One hundred and thirty nine samples of gum-arabic were examined mainly for the Silviculturist in connection with the investigation into the cause of "stringiness" which occasionally appears in this product. In addition various samples of gum dust were analysed for impurities and others were examined with a view to determining their specific origin.

Other samples included in this category were two blankets for estimation of the various constituent fibres, a sample of Papyrus grass under consideration as a raw material for paper manufacture, samples of beeswax, red lead, and various waste products were examined with a view to finding a use for them in industry.

INVESTIGATIONS.

Once again, shortage of staff, particularly in the second half of the period under review, seriously restricted the amount of work of this nature that it was possible to undertake, but several of the investigations initiated last year were completed, written up and published.

Identification of plant poisons in toxicological specimens.

Many poisonous plants, about the active principles of which very little is known either from a point of view of identity or means of detection, occur in the Sudan, and work was carried out with a view to being able to recognise some of these when present in postmortem viscera and similar specimens. The materials were treated by the well-known Stas-Otto process, to find out where the active principles would show themselves if at all, in the Bamford's scheme of identification.

The plants examined were the following :—

(a) **Lupinus termis.**

These seeds are a well-known article of diet in Middle East countries and contain a mixture of alkaloids amongst which lupanine and sparteine may be cited. These are all water soluble and may be removed from the seeds by soaking prior to their use. However casualties have been known to occur with these seeds, and a series of tests for these alkaloids was described, the principal one being the brilliant red colour given with alcoholic paradimethylaminobenzaldehyde on evaporation to dryness.

(b) **Clitoria ternatea.**

This species, which is being extensively cultivated as a foodcrop in the Gezira and which may also have possibilities as a human foodstuff, was shown to be free of alkaloids, although an alkaloid having a curare-like action has been reported in the related species *Clitoria arboreascens*. Particular attention was directed to the possibility of the presence of hydroxyanthraquinone or other purgative principles in view of an earlier report claiming purgative properties for these seeds, but none could be detected, nor did any effect of this nature show itself when the seeds were administered to animals. The seeds contain a blue dye with indicator-like properties, but no poisonous principle of any kind could be detected.

(c) **Cassia nigricans.**

A small specimen of this plant was received in connection with a poisoning case, but it was shown to be free of alkaloids and had no connection with the death, which was due to opium. However, the presence of hydroxyanthraquinones was indicated, a fact in keeping with the well-known purgative properties of the plant, which is employed for such purposes in several African countries.

(d) **Calotropis procera.**

This plant, known locally as Usher, is known to be very poisonous and to contain a mixture of cardiac glucosides. Alkaloids were found to be absent, and none of the characteristic colours with the usual reagents were given by extracts from the Stas-Otto process. However, the aqueous solution remaining after this extraction gave precipitates with Wagner's and Dragendorf's reagents but not with any of the other general alkaloid reagents. It also gave a blue-green fluorescence in ultra-violet light. The acid-petroleum-ether extract gave a very characteristic odour.

Effect of growth substances on cottonseed .

Experiments were started on the effect of auxins on the yield and composition of cottonseed. The substances used were 2 : 4 : 6 trichlorophenoxyacetic acid, pentachlorophenoxyacetic acid and pentachlorophenoxyisobutyric acid, which were supplied to the growing plants in their irrigation water at concentrations of 10 and 50 parts per million. Plants receiving the auxins grew more rapidly, and the bolls grew and ripened more rapidly than the controls, but those receiving the higher concentrations showed definite signs of toxicity. It is intended to examine the oil of the seeds from cotton-plants grown under different conditions and observe if the artificially enhanced rate of growth leads to a reduction of the linoleic acid content and increase in the oleic acid as has been observed in certain species when increased rate of growth is achieved merely by varying the climatic conditions.

Vegetable oils.

Work to obtain further information as to the effect of temperature on the fatty acid composition of seed oils was continued, seeds of the species *Camelina sativa* received from Sweden having been successfully grown in the Sudan, and the crop harvested and the seed oil produced under tropical condition extracted for analysis.

The survey of seed oils has been further extended to include the species *Clitoria ternatea*, and *Entada phaseoloides*, both of the Leguminosae Family. Both species were shown to contain higher saturated acids in common with all other species of this family which have been previously examined, and the presence of these appear to be a general characteristic of the entire family.

Gum Arabic.

The work that has been in progress during the last two or three years to endeavour to elucidate the cause of stringiness which occasionally occurs in samples of gum arabic has been continued. Samples taken from marked individual trees from three different localities, and collected at three successive times during the gum season, have been examined by an empirical test for the presence of stringiness, the weight yielded by each tree being recorded and conditions of rainfall, size and age of tree, type of soil and other variables being known. Information gained this season supported the contention put forward last year that the first tapping usually gives a higher proportion of stringy gum, this undesirable property tending to disappear later in the season.

Analysis of ferruginous minerals for minor constituents.

The investigation reported last year has been completed, thoroughly tested out and published elsewhere (*Analyst*, 1954 pp. 95-100). This method has now been introduced with success for the routine examination of iron-stones from the Red Sea Hills which are submitted for analysis by the Geological Survey, and it gives satisfactory results in the estimation of iron, titanium, vanadium, manganese and phosphorus. One of the main difficulties encountered was the removal of chromium, which if present in more than very minor amounts, vitiates the vanadium and titanium determinations. This is best removed by oxidation to chromate by alkaline hydrogen peroxide, excess of the latter being destroyed by boiling. The solution is then acidified, cooled and extracted with cold ethyl ether, hydrogen peroxide being added in small quantities with vigorous shaking. This converts the chromate into the deep blue "perchromic acid" which is very soluble in ether, and so is removed from the mixture.

Care must be taken in the estimation of phosphorus if vanadium is present, as ammonium vanadomolydate is co-precipitated with the phosphomolybdate. But if the latter be converted to magnesium ammonium phosphate by the well-known method of Schmitz, the precipitate is freed from vanadium.

Bricks.

Experiments were conducted in these laboratories by Mr. J. S. Robinson, of Horsham, Sussex, under the auspices of the Director of Works, with a view to improving the quality of locally made bricks. Clay from two pits at Omdurman, also from the Gir Pit and from Kilo 6 were examined, firing being conducted at 1050°C, 1100°C and 1150°C in each case.

No. 1 pit, Omdurman, was undoubtedly the most satisfactory clay, giving good hard bricks which were easy to mould, dried without cracking, extruded well and had a long range of temperature for maturing which would ensure safe burning conditions.

Pit No. 2 and the Gir Pit were also fairly satisfactory, but less so than No. 1 Pit, and were considered more suitable for the manufacture of refractories than building bricks.

The clay from Kilo 6, though more favoured from a point of view of accessibility, was considered unsatisfactory, as it contained lime which would tend to hydrate and carbonate, giving a brick liable to crumble. Furthermore, this clay had a dangerously short maturing temperature, firing at 1050°C giving a sandy brick of poor quality, while 1150°C caused melting. It was concluded that this material should only be used as a last resort.

Chironomidae.

Experiments which were inaugurated in 1951 in an attempt to relate the incidence of chironomids to climatic and other conditions were continued. Daily observations of the abundance of these insects have been made throughout the year, and it was evident that the main controlling factor was wind-strength during the day, a bad night usually following a day when the wind was 11 m.p.h. or more, during which the midges are blown to shelter on the banks during the earlier part of the day. There was no obvious relationship between temperature and abundance of midges except in so far as this factor influences wind conditions. During this season, fortnightly analyses of the oxygen content of Blue Nile water have been carried out, to discover whether this factor has any bearing on the prevalence of chironomids as observed in Khartoum.

Utilisation of the surplus guava crop.

Experiments had been carried out in recent years on the possibility of producing fruit squashes from the surplus crops of citrus, mangoes and other fruits which would otherwise be wasted, and although this proved perfectly feasible in these instances, with guavas it was not the case, as it proved to be virtually impossible to express the juice until the chopped fruit had stood for at least 24 hours, during which time a certain amount of alcoholic fermentation had set in, which was also accompanied by a certain degree of break-down of the cell walls, which permitted the juice to be expressed. Juice from both red and white guavas was analysed and shown to be closely similar in composition to that of apple juice, but had a vitamin C content amounting to about twenty times that of the latter.

It was clear that guava juice would make a satisfactory starting material for the manufacture of a cider-like beverage, and experiments were conducted to this end. A fair degree of success was achieved, but the main difficulty was that in order to produce a palatable beverage free from excessive acidity and having an attractive appearance, it was necessary to carry out the fermentation very slowly, a temperature of 50°F. being recommended for this. This of course would be costly to arrange in the Sudan.

In view of that fact that the total sugar content of guava juice is only about 8.5 per cent it would be impossible to produce a beverage of greater alcohol strength than about 4 per cent, and it is doubtful whether this would be sufficient to

give protection to the product for a long period without the use of preservatives. Further experiments were carried out in which the sugar content of the original juice was raised to 24 per cent by the addition of a strong aqueous solution of sucrose. Slow fermentation at 50°F of this liquor produced quite an attractive wine of about 10 per cent alcohol by volume, but once again low temperatures were essential for a good product to be achieved. It was found that there was sufficient yeast nutrient present in the fruit for the yeasts to feed upon, and addition of peptone for this purpose proved undesirable as it caused increase in speed of fermentation, with the development of undesirable off-flavours and poor colour.

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(3) THE SECTION OF MEDICAL ENTOMOLOGY.

BY DR. D. J. LEWIS.

As in previous years the Section was situated at the Gezira Research Farm, Wad Medani. The laboratory of the Bilharzia Research Section became available and made it possible to increase laboratory space and partially to solve the problems which had been due to the necessity for doing experimental work near stores of insecticide.

Members of the Section visited Darfur, Kordofan, Port Sudan, Wad en Nail and Wadi Halfa. Dr. Lewis, as a member of the W.H.O. Expert Advisory Panel on Parasitic Diseases, prepared three papers for, and attended, the first session of the Expert Committee on Onchocerciasis in Mexico City, and visited Southern Mexico where a campaign for the removal of nodules is in progress in *Simulium*-infected areas. The conclusions of the meeting are being published.

Numerous inquiries were answered and specimens identified. Many visitors were shown demonstrations of insects, and specimens were supplied to the British Museum, the Congo Museum in Belgium, the Cooper Technical Bureau, the Darfur Public Health Department, the London School of Hygiene, the Mosquito Control Officer and the School of Hygiene in Khartoum, and for study in New York. The exhibits of insects in the Graphic Museum in Khartoum were reorganised.

Thanks are due to the Mosquito Control Officer and many others who contributed useful specimens; the Government Analyst for observations on Chironomids; the Medical Inspector, Dongola for information about *simuliids*; the Commonwealth Institute of Entomology for the use of its identification service; Dr. J. R. Busvine for tests on B.H.C.—resistance; and the Imperial Chemical Industries Ltd. for samples of orthodichlorbenzene.

COLLECTIONS RECEIVED FOR IDENTIFICATION.

In 88 collections, received from many places, 2433 specimens were identified. They included collections of sandflies from the outbreak area of kala azar in Kenya. Eighteen snakes were received from Wad Medani where *Atractaspis microlepidota* is common. Specimens from aircraft were as follows: Juba, September, aircraft from Nairobi, *Culex* sp., three females; Port Sudan, 18.1.54, aircraft from Asmara via Aden, *Culex fatigans*, two males, four females, Chironomid, one female.

INSECTICIDES.

The space spray supplied by the Controller of Medical Stores is no longer made from pyrethrum powder. The new formulation recommended comprises 0.05 per cent. pyrethrins and 0.4 per cent. piperonyl butoxide in kerosene.

Insecticidal resin was received for testing but the accompanying accelerator did not survive the journey from overseas. Even if better containers are devised it remains to be seen whether resins are too costly for local use.

Other information on insecticides is included in sections below.

LICE.

Tests were begun, with equipment supplied by the World Health Organisation, to ascertain if lice in the Sudan have developed any resistance to insecticides. In preliminary tests lice from Wad Medani showed some resistance to treatment with D.D.T. at the low concentration of 0.1 per cent., but lice from some Maringan and Gezira villages were susceptible. Large scale de-lousing has not been carried out since 1947 and it was not expected that much resistance in lice would be detected.

HEMIPTERA.

Leptocimex boueti was found biting people at Wad Medani. This species is sometimes common in bat roosts and some descend into rooms and bite people.

SANDFLIES.

A *Phlebotomus* survey was made in and around Sennar in October and November, and in neighbouring villages in November, at the request of the Senior Medical Inspector who reported on unusual number of cases of kala-azar. The 1355 specimens found in this survey and in collections made subsequently by Public Health staff near Sennar Hospital are as follows :

	Near Sennar Nov.	Sennar					Total
		Oct.	Nov.	Jan.	Feb.	Mar.	
<i>P. Papatasi</i>	...	1	0	0	0	0	1
<i>P. lesleyae</i>	...	37	16	24	22	15	114
<i>P. adleri</i>	...	2	1	3	0	0	7
<i>P. christophersi</i>	...	0	7	0	0	0	7
<i>P. clydei</i>	...	117	47	193	24	7	450
<i>P. antennatus</i>	...	119	115	376	53	7	677
<i>P. bedfordi</i>	...	1	0	1	0	0	2
<i>P. schwetzi</i>	...	2	3	2	0	2	9
<i>P. freetownensis</i>	...	3	11	4	0	0	18
<i>P. squamipleuris</i>	...	41	8	21	0	0	70

It is very interesting to note the large numbers of *P. lesleyae* which was common at Sennar and was found in every village examined. This species, which is allied to *P. argentipes*, the Indian vector of kala-azar, was hitherto known as an interesting rarity occurring in several kala-azar areas of the Sudan. *P. orientalis*, the vector at Hawata, has not been found at Sennar.

Of 894 sandflies collected in Darfur and Kordofan only one, from El Fasher, was *P. orientalis*. There were 576 *P. antennatus*, mainly from Kcbkabiya and Kutum.

ANOPHELINE MOSQUITOES.

The Fung.

The Senior Technical Assistant started a mosquito survey in connection with a malaria survey following the raising of the Sennar reservoir. Many mosquitoes were identified and *A. rupipes* was found to be common in certain villages.

Tilapia melanopleura was supplied for weed control in the Wad en Nail Canal.

The Gezira Irrigated Area.

The Medical Entomologist made a reconnaissance flight with the Assistant Province Medical Officer of Health in August to inspect the very extensive rain water floods. Aerial spraying had been considered, but it was concluded that most of the water surface was unsuitable for *A. gambiae*.

Although villages are treated with residual B.H.C., anti-larval measures are being continued for the present. For many years larvicides have been used around the Research Farm and in recent years D.D.T. in oil was applied by special staff in neighbouring blocks, but it was not feasible to extend this arrangement to the whole irrigated area. This year, however, oiling by tenants was gradually introduced as a substitute for baling, a time honoured but laborious process which increases the risk of infection with schistosomiasis. This Section cooperated by making check inspections. The efficiency of the work varied considerably from place to place, but the same had been true of baling. Oiling affects more breeding places than baling and can start earlier in the season. If the effect of residual spraying on the malaria incidence is eventually considered sufficient to justify reducing or abandoning anti-larval measures, oiling might at first be stopped in the dry season far from villages.

Regarding the question of relying entirely on residual sprays, it is interesting to note two reports from abroad. Around Lahore larvicidal and imagocidal measures are used (Hamid, 1953, Pakistan J. Health); and Henderson (1952, Ind. J. Mal., 6, 73-116) considers that residual insecticides, although the chief weapon against malaria, may never be completely effective in all irrigation schemes.

Observations were made to find out if copper sulphate, used for weed control, at 2 parts per million, or for snail control, at 0.125 parts per million, had any effect on *A. gambiae*. There was some evidence that the former dosage had some local effect, presumably through its action on the algal food of larvae.

Experiments with *Tilapia melanopleura* have shown that it may partially check weed growth in certain canals for a limited time. Further observations would require special staff, but it is not possible to hope for much success owing to the presence of predatory fish.

The coastal area.

A. gambiae is very rarely found near the coast, but this year there were a few specimens in collections from Erheib, Kaniob Sanha and Port Sudan.

Wadi Halfa area.

No anophelines were received or malaria reported, and no *A. gambiae* were reported from Egypt, or from the Sudan north of Ferka. Parts of the Second Cataract were inspected but no larvae found.

CULICINE MOSQUITOES.

Monthly reports on returns of surveys of *Aedes aegypti* were prepared for the World Health Organisation and for the Director by the Senior Technical Assistant in his capacity as Aedes Control Officer. *A. aegypti* was reported to be rare or absent in most places.

Aedes vittatus, one of the potential vectors of yellow fever, was found by the Mosquito Control Officer at Gebeit, its most northerly known locality in the Sudan.

Toxorhynchites brevipalpis was found for the first time in the Gezira, at Er Ruf. This species feeds on the larvae of *Stegomyia* mosquitoes.

The control of *Culex pipiensf atigans* at Port Sudan involved special attention to septic tanks which have been increasingly used in recent years.

CHIRONOMIDAE.

Investigations indicate that the breeding area of the Chironomidae ("green nimitti") affecting Khartoum is in the region of 800 feddans or more of the river bottom. Owing to larval drift from upstream and other factors complete control may not be economically possible. The problem is however, so important in a section of Khartoum and at Wadi Halfa that an anti-larval experiment was carried out at Khartoum with the cooperation of the Senior Public Inspector and the Superintendent Engineer of Steamers. Two hundred and thirty one kilogrammes of BHC, D919 (13 per cent. gamma isomer), and 350 kgs. of technical D.D.T. were discharged, by means of a specially designed conveyor belt, over areas of 300,000 and 350,000 square metres respectively. To assess results a tow-net was moored below the treated area, the catches were sorted, and the species and numbers of pupae counted to see if the treatment affected the time of appearance at the point of observation. Results were not conclusive because during the work several aspects of pupal behaviour were discovered which necessitated a modification of the methods for future tests. No dead fish were detected despite careful search.

SIMULIIDAE.

The streams flowing from Jebel Marra were examined to find out if they produced simuliids which could enable a focus of onchocerciasis to exist. Vast numbers of simuliid pupae were found, but examination of these up to the time of writing indicates that three harmless species are the only simuliid inhabitants of the area.

Reports from Dongola showed that Citronella oil does not prevent *Simulium griseicolle* from settling. The best known means of personal protection against the grey nimitti is the use of veils to prevent settling on the head and dimethyl phthalate to prevent nimitti biting the wrists.

TABANIDAE.

A species new to the Sudan, *Haematopota wittei* Oldroyd, from Unwishi, was received from the Veterinary Entomologist.

CALLIPHORIDAE.

The information on 41 species of calliphorids was collated for publication, with detailed references to *Chrysomyia albiceps*, *C. putoria* and myiasis.

The BHC resistance in Omdurman flies has been further investigated at the London School of Hygiene. The flies proved to be very highly resistant to BHC and moderately so to D.D.T.; and they were also moderately resistant to Aldrin, Chlordane and Dieldrin, which had not been used in Omdurman. Effective fly control there awaits further town planning and improved sanitation. Meanwhile tests were made with orthodichlorbenzene as a temporary expedient. The flies

were found to be susceptible to it, although resistant to several other insecticides, and larvae were easily killed under laboratory conditions. In pit latrines however ODCB killed few larvae of *Musca*. although in Wad Medani it destroyed those of *Chrysomia putoria*. The new insecticide, Diazinon, is being used experimentally in Omdurman by the Public Health Service.

OTHER ARTHROPODS.

Ornithonyssus (= *Lyponyssus*) *bursa* Berlese was received from El Obeid, Kigille and Wad Medani. This bird parasite which attacks human beings is sometimes troublesome in various parts of the Sudan.

Centipedes are not uncommon but are seldom reported to cause harm. A specimen received from Wau had bitten a child causing pain in the foot and thigh for six hours.

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CHAPTER X.

METEOROLOGY.

Table XXVIII shows the mean of the rainfall recorded in provincial meteorological stations:

TABLE XXVIII

PROVINCE		No. of Stations	Mean rainfall mms.	Highest recorded mms.	Lowest recorded mms.
Bahr El Ghazal Province	...	4	869	1,166	586
Blue Nile	...	10	487	956	212
Darfur	...	7	541	807	387
Equatoria	...	10	1,220	1,429	710
Kassala	...	10	341	603	20
Khartoum	...	3	200	219	171
Kordofan	...	10	565	961	207
Northern	...	5	93	129	49
Upper Nile	...	6	891	1,065	819

TABLE I.

SUDAN : 1953/1954

OUT-PATIENTS

NEW CASES BY DISEASES AND TOTAL ATTENDANCES

DISEASE	B.EL.GHAZAL	BLUE NILE	DARFUR	EQUATORIA	KASSALA	KHARTOUM	KORDOFAN	NORTHERN	UPPER NILE	TOTAL
1. Cholera ...	—	—	—	—	—	—	—	—	—	1
2. Plague ...	—	—	—	—	—	—	—	—	—	2
3. Smallpox ...	—	—	—	—	—	—	—	—	—	3
4. Typhus ...	—	—	—	—	—	—	—	—	—	4
5. Yellow Fever ...	—	—	—	—	—	—	—	—	—	5
6. T.B. Pulmonary	181	392	119	233	509	757	400	434	180	6
7. T.B. Non-Pulmonary	62	606	82	52	524	567	205	202	2,509	7
8. Pneumonia ...	811	8,069	3,241	3,213	2,119	4,995	5,110	3,329	32,936	8
9. Influenza ...	166	1,642	3,688	3,585	1,295	6,892	2,678	7,433	27,478	9
10. Other Respiratory diseases ...	13,320	185,968	50,723	105,685	95,916	121,641	129,998	81,800	36,704	10
11. Cerebrospinal Meningitis ...	7,412	183	176	15	63	23	379	22	669	11
12. Chicken-Pox ...	2,136	1,009	915	971	1,034	1,648	1,553	227	10,577	12
13. Diphtheria ...	56	10	4	20	584	75	51	4	335	13
14. Encephalitis ...	—	—	—	—	—	—	—	—	—	—
15. Measles ...	357	1,790	563	537	479	1,537	1,801	953	68	14
16. Mumps ...	16	5,802	214	1,696	584	841	1,842	—	8,913	15
17. Poliomyelitis, acute ...	—	—	—	—	—	—	—	—	12,038	16
18. Rheumatism, acute ...	354	2,189	151	1,414	166	809	476	1,591	7,884	18
19. Whooping cough	—	420	190	169	770	989	1,399	2,905	7,553	19
20. Dysentery ...	1,668	16,483	6,767	4,422	4,778	9,699	8,184	4,150	67,817	20
21. Gastro-enteritis of children ...	84	18,096	844	100	2,153	20,048	2,170	4,025	49,377	22
22. Undulant Fever ...	182	3	25	8	199	2	1	1	34	23
23. Filariasis ...	40	40	7	55	296	13	3	3	452	24
24. Leishmaniasis ...	391	24,025	54,567	41,846	15,116	76,685	16,706	17,692	336,230	25
25. Malaria ...	5,873	83,720	1	—	—	1	—	—	3	26
26. Blackwater Fever	—	—	—	8	—	—	—	—	90	27
27. Onchoeroisis ...	82	—	—	5	—	4	—	43	—	28
28. Phlebotomus Fever	—	—	53	—	—	—	—	—	52	29
29. Relapsing Fever	—	—	204	7,068	11	18	—	122	51	30
30. Trypanosomiasis	1,137	73	75	1,687	166	49	585	6	8,830	32
31. Ancylostomiasis	553	106	3,031	3,835	555	1,782	7,271	4,271	3,568	33
32. Dracontiasis ...	313	9,541	5,401	3,392	3,440	5,357	7,050	1,202	30,725	34
33. Schistosomiasis ...	1,736	6,198	202	376	140	579	999	52	36,120	35
34. Gonorrhoea ...	133	18,704	18,590	32,242	7,465	11,182	9,595	4,393	3,301	36
35. Soft Sore ...	—	—	1	14,851	—	—	—	—	1,37,195	37
36. Syphilis ...	7,074	—	8	4	—	—	—	—	29,629	38
37. Yaws ...	5,761	—	—	53	—	—	—	—	45	39
38. Anthrax ...	—	—	227	7,068	11	18	—	123	91	30
39. Hydrophobia, human ...	—	—	73	3,031	3,835	555	4,271	1,26	204	31
40. Madura Disease ...	78	136	89	1,161	24	—	—	34	1,594	41
41. Tetanus ...	—	680	23	—	51	36	34	2	1,749	42
42. Heat Stroke ...	17	42	10	17	11	19	19	16	159	43
43. Syndrome ...	—	—	4	—	16	—	2	3	961	53
44. Confinements ...	196	480	103	376	166	1,217	461	186	27	44
45. Gynaecological ...	94	5,742	1,390	70	1,932	9,993	19,944	1,569	3,216	45
46. Diseases of Pregnancy and Parturition ...	8	341	128	171	37	843	4,102	194	31	46
47. Puerperal Fever ...	—	75	11	3	18	91	60	60	5,824	47
48. Wounds and Injuries ...	33,005	226,970	97,345	167,013	131,737	114,091	152,907	82,463	1,057,467	48
49. Tropical Ulcer ...	5,257	5,208	11,050	1,545	1,545	462	5,302	17	38,270	50
50. Diabetes ...	—	152	25	7	—	552	496	458	1,891	51
51. Pellagra ...	—	3	43	1	352	1	4	4	58	52
52. Scurvy ...	—	85	74	93	—	17	255	85	961	53
53. Neoplasms, Malignant ...	12	26	502	29	46	79	165	65	72	54
54. Neoplasms, non-malignant ...	38	3,147	216	86	865	215	946	453	6,026	55
55. Trachoma ...	40	90,774	9,563	483	9,648	42,683	8,207	45,528	210,220	56
56. All other eye diseases ...	—	169,164	48,050	50,048	75,229	71,185	86,683	82,329	634,713	57
57. Ear diseases ...	—	6,303	42,582	18,561	11,957	17,351	17,286	20,003	163,878	58
58. Skin diseases ...	6,572	26,579	29,616	31,905	8,885	12,379	36,952	12,150	175,001	59
59. Alimentary diseases ...	—	11,937	245,133	87,584	88,888	105,935	135,965	129,521	37,188	60
60. Circulatory diseases ...	281	8,418	5,143	384	8,692	10,703	24,253	10,219	68,177	61
61. Genito-Urinary diseases ...	210	28,568	11,437	689	9,326	18,390	35,032	15,484	120,511	62
62. Organic Nervous diseases ...	13	258	2,103	1,598	5	486	1,105	1,811	1,375	63
63. Functional Nervous diseases ...	—	19	35	5	—	372	7	309	—	64
64. Nervous diseases ...	5,502	26,991	13,934	16,923	18,176	69,076	10,321	24,074	23,428	65
65. Fever of uncertain origin ...	—	182,065	36,875	93,197	68,335	83,921	99,619	57,643	208,425	66
66. All other conditions ...	24,080	31	1,022	—	116	20	26	623	683,615	66
67. Poisoning... ...	—	—	—	—	—	—	—	—	1,838	67
Total New Cases	1,52,109	1,428,668	502,226	690,203	627,636	794,552	947,156	627,161	314,908	6,084,619
ATTENDANCES: MEN ...	272,750	1,214,825	467,680	559,549	616,747	795,479	618,916	491,378	297,444	5,334,768
WOMEN ...	101,357	758,947	345,418	290,919	263,494	659,537	521,474	471,158	195,337	3,607,641
CHILDREN ...	271,609	1,206,291	440,071	381,217	452,737	669,068	649,883	851,744	251,045	5,173,665
Total Attendances ...	645,716	3,180,063	1,253,169	1,231,685	1,214,084	1,790,273	1,81			

ADMISSIONS AND DEATHS BY DISEASES.

DISEASE	BAHR-EL-GHAZAL		BLUE NILE		DARFUR		EQUATORIA		KASSALA		KHARTOUM		KORDOFAN		NORTHERN		UPPER NILE		TOTAL	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
1. Cholera ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2. Plague ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
3. Smallpox ...	1,013	172	6	—	1,767	221	94	—	—	—	—	—	140	20	—	—	10	—	3,030	413
4. Typhus ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
5. Yellow Fever ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
6. T.B. Pulmonary ...	117	27	315	29	72	12	190	14	391	17	425	28	219	33	237	11	109	8	2,075	179
7. T.B. Non-Pulmonary ...	57	6	139	8	32	11	48	3	172	2	117	4	71	6	106	1	56	1	798	42
8. Pneumonia ...	517	27	1,067	64	824	36	1,678	92	858	47	1,087	32	1,874	103	353	34	414	19	8,672	454
9. Influenza ...	2	—	12	—	91	2	440	14	133	—	247	1	90	—	101	—	17	—	1,133	17
10. Other Respiratory disease	360	2	1,666	42	373	4	879	3	1,396	21	558	4	1,118	18	673	7	417	7	7,440	108
11. Cerebrospinal Meningitis	7,412	550	150	43	176	17	15	2	58	21	23	—	379	77	22	8	669	109	8,904	827
12. Chickenpox ...	1,084	34	158	2	473	5	394	—	244	1	76	—	739	3	49	—	102	—	3,319	45
13. Diphtheria ...	—	—	56	10	2	—	4	1	16	3	32	—	50	6	12	2	3	—	175	22
14. Encephalitis Lethargica ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
15. Measles ...	250	1	42	1	194	2	264	—	87	—	59	1	222	1	60	—	9	—	1,187	6
16. Mumps ...	12	—	26	—	60	—	277	—	27	1	36	—	166	—	8	—	4	—	616	1
17. Poliomyelitis, acute ...	—	—	—	1	—	—	—	—	2	—	—	—	—	—	1	—	—	—	5	17
18. Rheumatism, acute ...	69	—	132	—	26	1	74	—	34	—	44	—	59	—	101	—	15	—	554	1
19. Whooping Cough ...	—	—	25	1	10	—	41	1	11	—	98	3	106	3	21	—	5	—	317	8
20. Dysentery ...	392	15	638	39	656	18	553	20	426	6	704	10	411	7	401	8	565	18	4,746	141
21. Enteric Fever ...	7	—	99	6	7	1	28	1	21	1	54	—	6	—	238	24	12	1	472	34
22. Gastro-enteritis of children	6	—	131	12	40	7	84	5	75	19	174	22	150	1	146	22	69	—	875	88
23. Undulant Fever ...	—	—	3	—	1	—	8	—	10	1	9	—	1	—	—	—	1	—	34	23
24. Filariasis ...	41	—	2	—	1	—	73	—	2	1	—	—	—	—	—	—	—	—	121	1
25. Leishmaniasis ...	—	—	286	24	6	—	48	6	295	31	13	—	3	—	—	—	130	11	781	72
26. Malaria ...	1,568	21	2,549	53	746	20	4,527	103	2,173	26	678	3	2,818	43	569	2	525	23	16,153	294
27. Blackwater Fever ...	—	—	1	—	—	—	—	—	1	—	—	—	1	1	—	—	—	—	3	27
28. Onchocerciasis ...	76	—	—	—	—	—	8	—	—	—	—	—	—	—	—	—	—	—	84	—
29. Phlebotomus Fever ...	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	29
30. Relapsing Fever ...	—	—	—	53	4	—	204	2	—	—	—	—	—	—	37	4	—	—	91	8
31. Trypanosomiasis ...	—	—	—	—	—	—	2,866	15	3	—	10	—	2	—	42	1	7	—	204	2
32. Ancylostomiasis ...	956	8	15	1	108	—	1,479	10	60	—	104	1	70	—	136	—	26	4,009	32	
33. Dracontiasis ...	152	—	34	—	25	—	233	1	31	—	15	—	79	—	2	—	19	—	590	1
34. Schistosomiasis ...	137	1	425	12	46	—	1,307	1	326	1	29	—	375	—	104	—	26	1	2,483	25
35. Gonorrhoea ...	1,056	2	152	—	242	5	1,624	7	1,946	5	237	—	98	1	1,020	3	193	3	984	—
36. Soft Sore ...	2	—	10	—	23	—	835	—	—	—	—	—	—	—	—	—	—	903	1	
37. Syphilis ...	685	3	244	4	1,624	7	1,946	5	237	—	—	—	—	—	—	—	—	—	7,030	37
38. Yaws ...	333	1	—	—	1	—	835	—	—	—	—	—	—	—	—	—	—	—	2,070	2
39. Anthrax ...	—	—	8	—	7	—	14	11	—	—	—	—	—	—	—	—	—	32	48	
40. Hydrophobia, human ...	—	—	7	2	138	1	2	—	—	18	—	13	—	5	5	2	5	4	33	40
41. Leprosy ...	48	9	14	—	1	—	39	—	75	—	41	1	25	—	7	5	—	—	246	10
42. Madura Disease ...	—	—	102	—	13	—	39	—	75	—	41	1	25	—	3	—	3	—	298	1
43. Tetanus ...	17	4	42	15	10	6	16	6	12	8	22	6	12	5	13	2	16	7	160	59
44. Heat Stroke Syndrome ...	—	—	—	—	—	—	17	1	—	—	—	—	—	—	—	—	—	—	18	43
45. Confinements ...	196	6	480	17	95	4	379	9	184	6	704	11	273	7	192	11	64	2	5,267	73
46. Gynaecological ...	71	1	1,608																	